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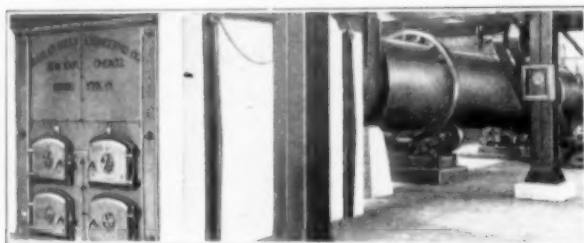
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Suggesting the Old Divining Rod

THE DESIRE to detect the presence of valuable mineral deposits in the earth without engaging in the arduous and expensive task of digging for them has always appealed to men, whether engaged in mining or not. Knowing that ores and minerals of fabulous value have been located and uncovered by one means or another, it is not surprising that human ingenuity should be requisitioned in an effort to "see into the ground" and thus gain a substantial advantage in locating needed materials and acquiring wealth. Thus we have run the gamut of devices from the divining rod of the charlatan to the more pretentious and reasonable machines for measuring electrical resistance in parts of the earth's crust. The common characteristic of all of them is that they do not "work." That is, no important and valuable mineral bodies, metallic or non-metallic, have been located by their use, save only extensive magnetic surveys to fix the approximate position of large superficial deposits of iron ore.

But hope springs eternal; and where should it be more aspiring than in Germany? Reduced to financial straits and having to rely mainly on economic resources with which to pay her bills and rehabilitate her industries, what more natural than that her subjects should turn to ready means of discovering hitherto unknown mineral deposits within her borders? And since physical exploration takes time and money and offers no certainty of result why not devise means for doing this from the surface and thus steal an economic march on the rest of the world?

Comes now therefore out of Germany "processes and practical means . . . developed to a high state of perfection for definitely locating many mineral and non-mineral deposits in the earth, from above ground." We confess to skepticism. It sounds suspiciously like the "stannophone" which excited so much merriment at the last New York meeting of the A.I.M.E., and by means of which the presence of tin in the earth's crust could be detected by the "cry" of the metal.

But in this case our interest is held and our skepticism perhaps modified by assurance on the part of a responsible investigator that he has "investigated the matter most thoroughly for several weeks," and further, that he has "gone to great pains to have some particular indications of the apparatus checked by borings." We let Mr. HOLZ speak for himself elsewhere in this issue in a letter which he has written from Germany. His opinion and judgment in other matters have been sound and have commanded respect. He has sponsored useful scientific devices well known in the metallurgical world. Whether he has been deceived in this instance remains to be seen, and we shall wait with interest for further developments.

The Engineer And His Thinking

AT THE organizing conference of the Federated American Engineering Societies held in Washington last June one of the speakers referred to "the kind of thinking" of the engineer. Not once, but many times, was the phrase reiterated, in varied form, until it became the theme of the speaker in his argument for the recognition of the engineer, scientist and technologist as a potent but neglected force in public affairs. "It is the engineer's thinking for which he seeks recognition, as well as his works." The phrase is worthy of closer inspection and analysis. What is the engineer's kind of thinking? How does it differentiate him from his fellow citizens; from lawyers, financiers, business men, merchants, clerks, the men on the street? What leads him to do his kind of thinking? And what is, or would be, the value of bringing that kind of thinking to bear on public affairs?

A man's habit of thought is the product principally of his environment—of his associations, training and experience. Out of them he acquires a characteristic viewpoint that determines his activities and modifies his opinions. From them he gets his ideas of efficiency, responsibility, fitness, integrity and reliability, all of which affect his usefulness as a citizen as well as his worth in his occupation. Measured by this yardstick let us see what kind of thinking we may expect from the engineer.

His training and education bring him early into contact with the inexorable laws of nature which are the foundation of his later work. With these he may not trifle and yet gain success. No amount of brilliant and clever argument will enable him to ignore the simplest laws of physics and mathematics. If he were not inherently honest he would soon become so or retire as a failure in his profession. Facts must be faced; materials of construction must be used for purposes for which they are best fitted; efficiency must characterize the performance of a machine; analysis must prevail instead of guesswork; tradition must be abandoned in favor of absolute knowledge; reason must prevail and law must be obeyed. The whole preparation of the engineer for his professional work makes him exact, precise, honest, efficient, unshackled by tradition, aggressive in attacking a problem, sound in analysis and judgment, and fearless in execution.

All of these are splendid traits and qualities for citizenship and government as well as engineering. In fact we are beginning to recognize government as a vast engineering undertaking, in which the fitness and integrity of men are fundamental necessities. By his training the engineer will bring a broader mind to bear on public problems than will the lawyer, financier or merchant. He will select men with much the same

care and investigation that he selects materials. He will demand efficiency and good management, because those things are essential to successful business, and government is the greatest business of all. He will excel at organization and management, for these elements are primary in his scheme of things. And when it comes to great public works which are essentially engineering there is no argument as to the necessity for technical control and direction.

The engineer's kind of thinking fits him for almost any position in our scheme of government, unless it be in the judiciary; and even there we have increasing evidence of the need of technical advice. But certainly in the executive and legislative branches of government the engineer can find a widening field for his services. Officials, boards and commissions are in growing need of his advice and counsel. Civilization is becoming more complex, research and investigation are bringing to light things unknown to the non-technical citizen, and government is demanding wider and more comprehensive knowledge. Respect for law and order, which lies at the very basis of the engineer's training, is the imminent need of the world. These are the things for which the engineer's kind of thinking fits him, and to which he can bring a new and valuable force in his capacity as a citizen and government official.

State Ownership of Radium in New York

THERE are several interesting phases to the recent purchase by the State of New York of two and one-quarter grams of radium salt valued at \$225,000. In the first place, it is the first instance in the United States of public purchase and control of a therapeutic agent. But more important, perhaps, it marks the conservation for domestic benefit of a resource that our country was in danger of squandering; New York's supply of radium was produced from carnotite ore mined in Colorado and refined in New Jersey. Further it is an example of public benefaction in the interest of all the people, after years of experiment which demonstrated fully the value to the substance as a cancer cure.

Of the therapeutic value of radium emanations in the treatment of cancer we have no doubt. The testimony of eminent physicians is in accord on that subject, and in the past few years there has been a sufficient quantity of radium available in several hospitals to make experiments in large numbers. Private philanthropy in co-operation with federal agencies was hitherto largely responsible for making available substantial quantities of radium—much more than private practitioners could afford and more in one lot than was collected elsewhere. It has remained for New York, however, to take the step which it has long been evident must be taken by either state or federal governments if the people are to benefit materially and quickly from this great natural resource. And while New York has made the purchase for the benefit of all the people and will extend service gratuitously without regard to state residence, other states should follow her example. It is known that the resources of the United States in radium are limited; and the world's supply, for that matter, is not large. And if all that has been and will be produced were to be applied to scientific and medical purposes, it would still be an expensive substance calling for Government purchase and control. The use of radium in the arts is inconsistent with its value and should be discouraged.

Iron and Steel Export Trade

THERE are various ways of looking upon the matter of iron and steel export trade. The worst way is to consider it a means of relieving ourselves of surplus product, or of "dumping" the tonnage needed to enable the iron- and steel-making industry to operate at capacity, so that the production cost of the entire tonnage may be reduced. "Dumping" was developed by the Germans as a system prior to the war; at no time was it a settled policy of American manufacturers, though to a limited extent it was practiced in a few of the years of the last decade of the nineteenth century. As a rule our iron and steel exports rise and fall much as our production fluctuates, whereas if we were exporting for the purpose of working off surplus product or engaging surplus capacity exports would fluctuate inversely to the fluctuations in domestic demand.

From the national economic standpoint iron and steel exports may be viewed as helping greatly to make up our merchandise trade balance. The iron and steel exports reported for the fiscal year ended last June amounted to \$933,000,000, while our imports of iron and steel, including iron ore, totalled \$39,000,000, showing a favorable balance in iron and steel of about \$900,000,000. In all merchandise our favorable balance was \$2,873,000,000. Thus iron and steel may be said to have contributed almost one-third to the country's trade balance. While the criticism might be made that a favorable merchandise trade balance is not an unalloyed blessing at this time, much the same sort of comparison could have been made in the pre-war years, when the merchandise balance was absolutely essential.

After all, however, the nomenclature of statistics may be productive of misconception. What are "iron and steel exports"? They represent the commodities the Bureau of Foreign and Domestic Commerce has designated as to be included under the heading "iron and steel." There are included such diverse materials as scrap and wire nails, pig iron and enameled bath tubs, rails and typewriters. Now it is perfectly true that typewriters are made chiefly of iron and steel, but these materials also enter largely into the manufacture of passenger automobiles and trucks, which are not returned in the official statistics under iron and steel. Magnetos and transformers are also made chiefly of iron and steel, but they are not reported as such, being included with "electrical machinery and appliances," whereby they take their place, properly enough, with incandescent lamps, batteries, insulated wire and spark plugs.

We exported 553,860 gross tons of steel rails in the last fiscal year, which was certainly quite a tonnage, but the value assigned, \$32,000,000, was just on a par with the value of our exports of gasoline engines and fell short of the value of the steam locomotives exported.

From the economic viewpoint, which is what really counts, it makes a great difference whether an exported commodity represents largely minerals which are of low value in the exporting country but of high value in the importing country or represents chiefly the product of labor. A common view is that we ought to export the products of our labor and keep our mineral resources for ourselves, but it is quite unsafe to generalize. We have trillions of tons of coal in the ground and Italy has practically none. Why should we be indisposed to sell coal to Italy, but, on the other hand, sell to Italy

annually millions of dollars' worth of engines and typewriters? The essence of international trade is that of exchange. We should export what we can produce most readily, whether it is a rail or a typewriter, and import what we find it most difficult to produce. Rails and typewriters are totally different things, even though the statistics put them both in as "iron and steel."

Courts of Law Err

Through Lack of Knowledge

INSIDIOUS pleadings by lawyers in chemical patent cases and consequent decisions by misled judges are establishing mal-traditions which will work many wrongs in future cases. It is now said that "analogy defenses to novelty are substantially excluded in chemical cases."

A review of several cases shows that the courts hold that "reasoning by analogy in a complex field like chemistry is very much more restricted than in a simple field like mechanics"; that "chemistry is essentially an experimental science and that chemical prevision is as impossible today as it was in former times"; that "in chemistry you almost entirely fail to predicate the result—it is a mere question of result from experiment." Another court submits that "a machine which consists of a combination of devices is the subject of invention, and its effects may be calculated *a priori*; while a discovery of a new substance by means of chemical combinations of known materials is empirical, and discovered by experiment." Still another states that "analogy does not go a long way in chemistry."

Chemistry is an exact science and the field is quite readily predictable. The judges are confusing chemistry with the cookery practiced by the old alchemists. Were this attitude of the courts correct, the manufacturer of synthetic nitric acid, for instance, might hold patents for all reactions his product undergoes with other compounds, although easily predicted through the action of nitric acid made from Chilean saltpeter. The great mass of development work done in recent years is based on prediction by the research chemist.

Surely our modern scientists will not stand idly by while the judiciary calmly classifies present-day chemistry with the alchemy of the obscure ages, and through decision based on tradition brings disaster to important industries.

Materials Handling

Section of the A.S.M.E.

LAST week the initial meeting of the Materials Handling Section of the American Society of Mechanical Engineers was held in New York. ROBERT M. GATES, who has been most active in organizing the Section, stated that it must be a bureau of information—complete in its scope, specific in its knowledge of the physical and economic conditions and unbiased in its conclusions. This is to be done by having special meetings on particular subjects, meetings jointly with other sections, other organizations or associations, by taking part in all local and national problems relating to the purpose of the Section.

An invitation has been extended by Mr. ROTH to the Section to take over the Materials Handling Symposium to be held at the Chemical Exposition on the twenty-second of next month. In doing this the Section will perform its greatest function in bringing to-

gether the men who design the equipment and those who use it. F. M. FEIKER, in his address before the Section, emphasized the fact that it was not an interdiscussion among the engineers themselves on materials handling that was needed but the propagation of the best thought on these problems throughout industry. To do this in the chemically controlled industries, in our opinion, the Section can find no better medium than the Symposium to be held at the Exposition.

Considerable discussion was brought forth on what the scope of the programs should be. Some thought the limit should be set at studying the broad, underlying principles, some believed the matter should be taken up in the smallest details, and others thought the human element should be considered the center about which everything revolved. There is no doubt that materials handling embodies a problem having numerous factors and disregard of any one of them is apt to give bad results. However, it is probable that these factors will have to be pulled loose, picked apart and studied individually before any comprehension of the composite whole can be had.

In Support of the

Chemists' Club Library

LIBRARIES are the hallmarks of culture in our modern civilization, evidences of enlightenment, badges of learning, signs of national appreciation of art and literature. Among cultivated people they are supported with scrupulous care; under bolshevism, on the other hand, we are told, libraries are the first public institutions to suffer neglect and abandonment. The comment is significant.

Some time ago we raised our voice in the interest of libraries as important factors in the industrial development of cities and the regions surrounding them. Our reference at that time was particularly to the western part of the United States, but it applies with equal force to the East. Accordingly we are glad to lend our support to the appeal of the Chemists' Club library in New York City for funds with which to enlarge and extend its service to the chemically controlled industries of this country, and particularly in the metropolitan district.

There is no adequate measure of the value of a first-class complete chemical library, and aside from that of the Chemists' Club there is none in the United States worthy of the name. The Club is the logical custodian of such a library, and the industries in the metropolitan district are equally the logical beneficiaries of it if they will make use of it. It is estimated that 35 per cent of the chemical industries of the United States are located within commuting distance of New York, and it is inconceivable that their work can be conducted efficiently and profitably without the aid of the best library that it is possible to bring together. Only those who use a library constantly can realize how it supplements the laboratory and the plant. As evidence of the service which a complete chemical library can render, it is cited that the German Reichsanstalt, before the war, was able to answer directly from the literature about 80 per cent of the industrial problems submitted to it. The cost doubtless was insignificant in comparison with the expense that would have been involved in duplicating researches and investigations that had already been made. In urging the chemical industries to respond to the appeal of the Chemists' Club, we feel that we are presenting an opportunity for service to themselves.

Readers' Views and Comments

Is Synthetic Petroleum Possible?

To the Editor of Chemical & Metallurgical Engineering

SIR:—Of the many great problems now confronting the world probably none is greater than that of providing a bountiful and cheap supply of petroleum. The petroleum of the United States is now rapidly approaching exhaustion. What supplies may be hidden in the other parts of the world are as yet unknown, but in any event the cost of petroleum to the people of the United States must necessarily increase and go very much beyond that heretofore experienced. Sir E. Mackay Edgar last spring predicted that in ten years the United States would be buying from England 500,000,000 bbl. of oil annually. If this should occur the price to be paid would certainly be \$10 or more a barrel, which would make the price paid by our people a fabulous sum.

When it is known that petroleum is composed of approximately 80 per cent carbon and 20 per cent hydrogen, also the ease and cheapness with which these elementary substances can be procured, one naturally considers the possibility of producing petroleum synthetically from those elementary substances. In the belief that man is capable of so handling elementary materials as to form or produce any product that Nature has produced by the association of elements, the problem of the production of petroleum does not seem to be insurmountable.

To solve successfully the problem of the synthetic production of petroleum it is, of course, necessary that we have a starting point. The labor and time necessary for the accomplishment of the feat will be shortened by a thorough investigation of Nature's method. In the oil shales of Colorado, Wyoming and a number of our Western states it is conceivable that we have a starting point for this investigation. We have reasons for believing that the shale as removed from the earth does not contain petroleum, this product being produced by application of heat to the rock. Evidently Nature has so associated the carbon and hydrogen within the rock that the simple act of heating will cause their union in such manner and proportions as to produce petroleum.

There are throughout the United States many chemists who unquestionably would devote study to this problem if it were properly brought to their attention. Many of them have never seen a sample of oil shale nor are they situated so they can procure samples, but should the U. S. Bureau of Mines distribute liberal samples of the oil shale among chemists of the United States, with the suggestion that they endeavor to solve this all-important problem, it is not beyond the bounds of probability that within a very short period this question of the future supply of petroleum would be solved to the immense benefit of the American people.

Many suggestions are now being made that a substitute for gasoline be found. Much attention is also being devoted to the extraction of petroleum from our great deposits of oil shale in the Western states. The Government itself is devoting much attention to these

important subjects, but should this problem of the synthetic formation of petroleum be successfully solved in a thoroughly commercial manner all of these vexing questions would be settled. In fact, the results attained might extend beyond the fields we ordinarily consider as those belonging to petroleum. It is not at all visionary to believe in the possibility of causing carbon, from any of the many sources from which it can be obtained, to combine with hydrogen and create petroleum at sufficiently low cost and in sufficient abundance to be used as a liquid fuel. Such a fuel would use our carbon supplies in a much more economical manner than is now being practiced, as for instance where it is burned under a boiler for the generation of steam for power production with a loss averaging more than 85 per cent of the fuel value of the coal.

New York, N. Y.

EDWARD G. ACHESON.

Post-War Progress in Germany

To the Editor of Chemical & Metallurgical Engineering

SIR:—A careful survey of the metallurgical, chemical and electrical engineering progress in Germany during the past six years shows nothing new of importance to the U. S. A. The large manufacturing plants and research laboratories had to concentrate during that period entirely on war work and on the creation of substitutes for materials which were not obtainable on account of the blockade.

Nearly all the substitutes which were developed, mostly by the chemical industry, are of no value in peace times, especially since the cost of producing them is higher than the world market value of the genuine article. In some rare cases, where the real product can be purchased only in foreign countries and the substitute is manufactured in Germany at approximately the same price, the tendency still prevails to give the preference to the domestic substitutes, because Germany is forced to keep down to a minimum her importations and her payments to other nations.

An example of this kind is the paper textile industry, which was created during the war and is still quite active. Burlap from India ceased to come in soon after the beginning of the war in 1914, and millions of bags were sorely needed for the transport and storage of cement, sand and all kinds of products. Germany is still producing bags of paper thread and of a mixed burlap and paper thread that looks very much like the real article but does not stand the wear and tear of burlap, especially when moist. I do not believe that such paper bags or the German paper twine would ever be used in America. However, the German paper industry produces very nice rugs, colored in all shades and patterns, wall covering, table covers, window shades and similar articles, artistically decorated, very cheap and sanitary, perfectly satisfactory for the purpose. This industry may outlive the return of normal times.

Another industry which has come to stay in Germany is the manufacture of synthetic ammonia by the Haber process, the only one which permits the economical production of this material independent of the necessity

of cheap electric power. The large German aniline concerns are even at present increasing the capacity of their ammonia plants, not only in order to make Germany independent of foreign sources but especially to be able to export the material and to help pay the big bill.

Wonderful progress—entirely independent of war work—has recently been made in Germany in the utilization of physical forces about which theory still knows very little.

Processes and practical means have been developed to a high state of perfection for definitely locating many mineral and non-mineral deposits (ores, coal, salts, oil, gases, water, etc.) in the earth, from above ground, for accurately determining the position, depth, width and thickness of each such deposit, and for differentiating between the various materials forming the deposit.

The last named feature is of utmost importance; thus if the apparatus is adjusted for lead it is acted upon only by lead, and by nothing else and the number of materials it can be adjusted for amounts to over 100 and is constantly being increased.

Thoroughly practical and reliable apparatus has been developed for this purpose and is already being used with wonderful success in central Europe. Since very little gold is in the treasury of the new German Republic all the payments of billions of marks we hear so much about have to be made in coal, potash, metals and other contents of the earth.

The apparatus mentioned offers unlimited possibilities for locating new fields of mineral deposits and shifts the responsibility onto the laborer to get the stuff out of the German ground, which is full of valuable material. Very large deposits of oil, potash, coal, asbestos, etc., are present in Germany, the majority entirely untouched, and as a matter of fact they will not be touched until Germany knows definitely the amount of the bill it has to pay.

I have investigated the matter most thoroughly for several weeks and have gone to great pains to have some particular indications of the apparatus checked by borings. I have worked with the apparatus personally for quite a time and have also investigated the excellent work the inventor and his staff is doing right along for many prominent mining concerns and the government railroads.

What interests Americans much more than the results of these activities in Germany is the economic importance of such an invention to the United States. Certainly it should be carefully investigated by some governmental agency, and if what seems to be its everyday performance can be transplanted over the ocean, when in the hands of an ordinary field party, then the invention should be acquired by the United States Government.

The entire country could be surveyed, under the joint supervision of the United States Bureau of Mines and the United States Geological Survey, and the United States Government could then grant licenses to operating companies on a royalty basis.

If a practical working arrangement between the United States Government and the operators can be established—and there is no reason why this should not be the case—the financial returns to the Treasury would of course be immense.

HERMAN A. HOLZ.

Berlin, Germany.

Phosphate and Manganese Production in the Society Islands

Phosphate is the only mineral produced in or exported from the Society Islands. It is produced and exported by one company, the Compagnie Française des Phosphates, a French corporation with head offices in Paris, and with a capital stock formerly of 6,000,000 francs, all French owned, except for a relatively small amount held in Tahiti. The capital stock is now 11,000,000 francs. This concern, organized in 1908, has the exclusive mineral rights of the island of Makatea, which is about 120 miles north of Tahiti and has an area of roughly 1,200 acres. Two piers about 300 m. long, a part of which length, however, is on shore, have been constructed. Mooring buoys and lighters are used by the loading vessels.

MINING PROCESS IS SIMPLE

The phosphate, as exported, is virtually the soil itself, which is dug with pick and shovel and loaded on cars on a short narrow gage railway and drawn to the works, where it is put through crushing and drying processes. It is sold on a moisture percentage basis. After going through the drying process the product is stored in bins awaiting shipment. Most of the machinery used is of French manufacture.

At the present time nearly all the phosphate is exported to New Zealand. Before the war much of it went to San Francisco, some to Europe, particularly France, and a considerable quantity to Honolulu. It is expected that in the future the product will recover the markets of the pre-war period.

PHOSPHATE PRODUCTION

The phosphate soil shipped runs about 80 per cent phosphate, according to the statement of the manager of the company. Before the war the annual production was from 80,000 to 90,000 metric tons. In 1919 the production was approximately 40,000 metric tons, and it is reasonable to expect that the production will rapidly increase.

LABOR PROBLEM RESTRICTS PRODUCTION

The great difficulty encountered in this enterprise, as in all enterprises in this colony, is the difficulty of procuring suitable labor. At present the company employs about 500 workmen and employees, many of whom are Japanese. The French Government has recently enacted a decree providing for the importation of foreign labor, and fixing the conditions of such importation. It remains to be seen whether it will prove profitable to import such labor under the conditions prescribed but the probabilities are that it will, at least, for the phosphate company.

MANGANESE INVESTIGATIONS UNDER WAY

There is one island in the group which is known to contain manganese deposits. The owner of the mineral rights has engaged engineers to make an exhaustive investigation, and within the next three or four months it will probably be definitely determined whether there is manganese on this island in paying quantities and whether it can be profitably mined and exported. As matters stand now it is purely a matter of speculation as to whether manganese will be a commercial factor in the colony.



Decennial Celebration Forest Products Laboratory

An Account of the Two-Day Meeting at Madison Celebrating the Decennial Anniversary of the U. S. Forest Products Laboratory—Greater Co-operation on the Part of Industry Asked—National Forest Problems Discussed

EXTENSIVE conservation of our national wealth of wood through more efficient utilization was the keynote sounded throughout the decennial celebration at the Forest Products Laboratory at Madison, Wis., July 22-23. More than 200 visitors from all parts of the country were present, representing every line of wood-using industry, including fifty-nine wood-using associations and companies, eighteen lumber manufacturing associations and companies, the deans of twelve forestry schools, the United States Forest Service, and other visitors and friends. They came to pay tribute to the laboratory's ten-year record of service to American industry.

The opening session of the gathering convened in Agricultural Hall at 10 o'clock on the morning of July 22. H. F. Weiss was chairman. The program of addresses included Mr. Weiss's introductory remarks; "Legislative Measures for Forest Conservation," by Governor Philipp; "Translating Knowledge Into Power," by President Birge of the University of Wisconsin, and "The Forest Products Laboratory," by C. P. Winslow, present director of that institution.

After luncheon the program continued with inspection of the work and exhibits of the laboratory. Guides in charge of small parties showed the visitors the various lines of endeavor in which the laboratory is saving millions of dollars a year to the people of the country. Following the inspection trip was a period for recreation consisting of automobile tours around the city, boat rides, and swimming.

Nearly 500 prominent lumbermen, manufacturers and users of forest products, and members of the Forest Products Laboratory attended the banquet in the evening. Burr W. Jones presided as toastmaster. Lieutenant-Colonel W. B. Greeley, Chief Forester of the United

States, spoke on "Forests and National Prosperity." Following the address of Colonel Greeley, Max Mason, research specialist of the National Council of Defense, gave an illustrated talk explaining in detail the submarine detector which he perfected during the war and which was successfully used in European waters.

At the Friday morning session John Foley, forester for the Pennsylvania Railroad, was chairman, introducing the speakers as follows: D. C. Everest, secretary and general manager Marathon Paper Mills Co., "Some Problems of the Pulp and Paper Industry"; H. E. Howe, chairman research extension division National Research Council, "America's Place in Industrial Research"; and W. A. Gilchrist, representing the National Lumber Manufacturers' Association, on "Some Problems of the Lumber Industry."

MR. WEISS URGES GREATER CO-OPERATION

"The tendency of the time, I think, particularly on the part of Government and industry, is for these two to work too much apart, this being due largely to a lack of familiarity with each other," said H. F. Weiss, chairman of the opening session, in his introductory remarks. "I believe it is particularly necessary for the Government and the industries to co-operate more wholeheartedly if our country is to play a prominent part in the commerce of the world. In the Forest Products Laboratory the Government has established an institution which is doing much direct good for all of the wood-using industries and indirectly is doing good for all of us, because all of us use wood in some form or other."

Mr. Weiss then introduced the first speaker of the morning, Governor Philipp of Wisconsin.

"Nature would have been a great conservator of

forests if she had permitted trees to grow square rather than round," declared Governor Philipp during his reminiscences of the wasteful methods of the earlier days of the lumber industry.

"It is unfortunate for the country and unfortunate for the timber supply of the country that there was not some control even back in the '60s and '70s, when the great timber supply was here, that there was not some supervision that compelled the use of what we at that time regarded as the class of timber that had no commercial value for purposes to which it could be put and save the high-grade timber—the timber that we need so much today—for the future. But somehow our forefathers did not foresee it. We will not blame them."

REFORESTATION A NATIONAL PROBLEM

Concerning an advisable policy of reforestation Governor Philipp said: "This state has had some experience in reforesting. We have attempted, and we have made an honest attempt, to replant some of our cut-over timberlands. Now I have this to say about it. As a state policy it is not a possible thing today.

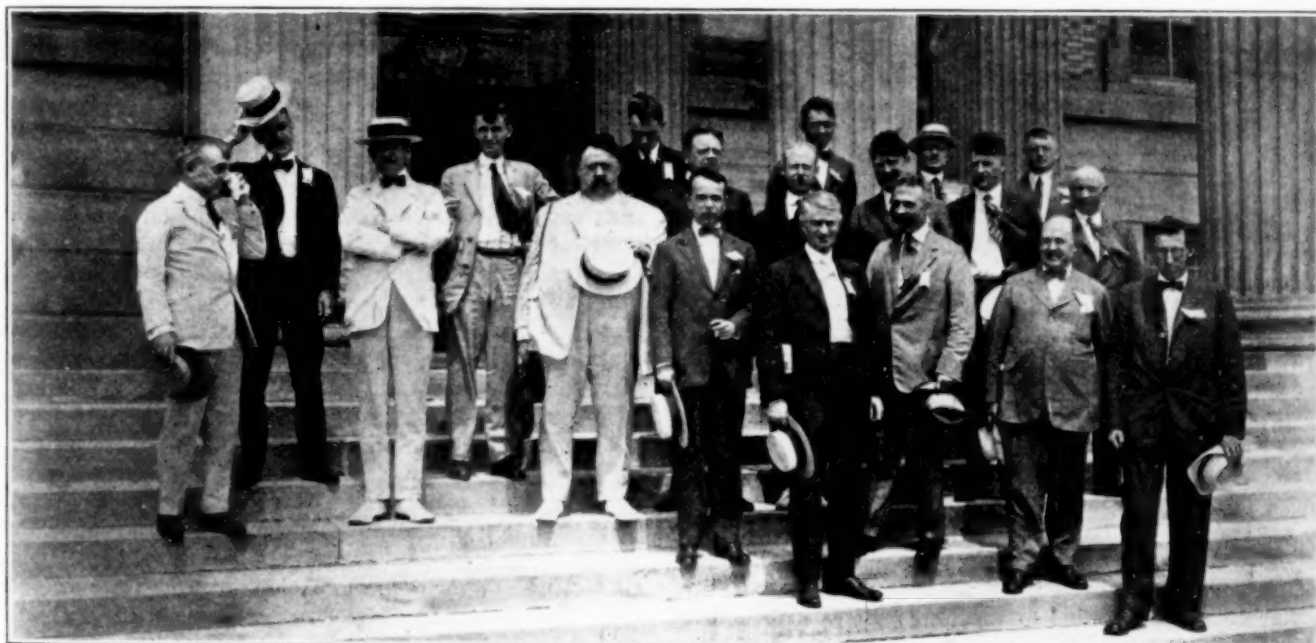
"The cost of the land, the cost of planting, the cost of the care that the plant needs, the taxes that the state loses provided it reserves this land for forestry purposes, make the price, if we compute it up to the time that the trees might become merchantable, so high as to make it an impracticable thing. Nor is it, in my judgment, a state duty. Let us assume that the state of

cause we at one time had a forest, and that those states that at one time had forests should now undertake this great business proposition, this great speculative investment, in order that the whole country might have a timber supply. That does not appeal to me. It is not a state duty, it is a national duty. The National Government should recognize it promptly and take hold of the future supply in an efficient manner. The timber supply of the future, the one which is produced, should be the supply of the entire country, and whatever it costs should be the expenditure of all of the people."

PURPOSE OF FOREST PRODUCTS LABORATORY

President Birge of the University of Wisconsin emphasized in his remarks the fact that during the last few decades the need had become apparent for a different type of institution, of which the Forest Products Laboratory is an excellent example. The speaker developed the idea that this organization is engaged in assimilating vast stores of technical knowledge accumulated to such an extent that no one man can grasp it all; and of translating these stores of knowledge into power that energizes industry and enables greater things to be done by better and less expensive methods.

Director C. P. Winslow, in speaking of the purposes and work of the laboratory, illustrated the manifold uses of wood in connection with the everyday life of the people. He brought out the great problems of conservation and utilization of forests, of cut lumber and of



SPEAKERS AND EXECUTIVE COMMITTEE

Wisconsin would plant in the northern part of our state a million acres of young pine. I do not know what it would cost to do it, nor does anyone else know. The best we could do is to make an estimate which would be liable to be wrong, but we would have to wait at least fifty years before we could get any merchantable timber. Now when that timber comes into the market it is not for the state of Wisconsin alone. If it were it would not be a supply for the country, and what we need is a supply for the whole nation. So then those who agitate that the state ought to undertake reforestation would do it upon the basis that it is a state duty merely be-

finished product. He stated that it was the broad purpose of the Forest Products Laboratory to aid the nation in solving these problems.

He said in part: "The Forest Products Laboratory is called an institution of industrial research. Its object is to acquire, disseminate and apply useful knowledge of the properties, uses, and methods of utilization of all forest products. This is a broad field of almost unlimited scope—the surface has as yet been but partially scratched."

Mr. Winslow gave statistics showing by conservative estimate that the work of the Forest Products Labora-

tory effected an annual increase in production and decrease in waste aggregating \$30,000,000. These figures, the speaker said, should prove the value and importance of industrial research.

In concluding, Mr. Winslow indicated the immense program of work yet to be undertaken by the laboratory, saying: "The Forest Products Laboratory is the only institution of organized research engaged upon the problems of these industries, and those problems yet untouched and unexplored are many and of far reaching importance. What, for example, of the possibilities which may result from the development of permanently durable and water-proof glues or adhesives and their application to the use of material too small or of too poor a grade for other service—what of their application to forest economics through the increased value thus given to small second growth material? What of the sulphite pulp liquor problem involving the possibility of utilizing the 55 per cent of the wood fed into the pulp digesters and now lost in the waste sulphite liquors? What of the problems of packing, boxing, and crating of various materials and commodities for shipment and transportation when conservative estimates show a possible theoretical annual saving to the country of \$300,000,000? What of the need for improvement and the method of treatment and handling of piling and dock timbers in water infested with marine borers which destroy the piling within eighteen months after placement and cause an annual replacement aggregating millions of dollars in the various harbors of the nation? What of the waning supply of hardwoods and the need for authentic knowledge of the properties of South American and other foreign woods as compared to those of our own country for which they may ultimately be needed as substitutes?"

CONSERVE AND GROW MORE FOREST PRODUCTS

Lieutenant-Colonel Greeley contrasted the extensive and often wasteful use of wood in this country with the frugality and care with which France conserves her very limited supply of lumber, and he praised the industry and foresight of a people who could build up within an area less than that of our largest state the great industrial nation that France is today.

"The lesson which such things brings home is, in a broad way, the same fundamental truth which underlies many economic problems of the present time—not alone those of America but of the whole world as it strives to get back to normal industry. It is an old and simple axiom. Aside from the will to work which is the foremost quality of any strong nation, its economic and social progress depends in the long run upon the foresight and efficiency with which its natural resources are used."

The speaker showed by statistics the extensive use to which wood has been put in this country and the urgent need of a yet greater supply—the need on the farm, in building houses, in our paper industry, on our railroads, in boxing and crating our commodities, and in our factories.

He spoke also of the diminishing supply of wood, stating that three-fifths of the original supply of timber in the United States is gone and that every year we are taking out of our forests four times the amount of wood that we are growing in them. Moreover, the availability of the remaining timber is rapidly becoming less. Half of the remaining timber of continental United States, Colonel Greeley says, is in the three states bor-

dering the Pacific Ocean. And the true index of timber depletion is not the quantity that is left but its availability.

Colonel Greeley indicated the reason for our decreasing wood supply and the cure for it as follows: "The real cause of our timber depletion is idle forest land. The area of idle or largely idle land is being increased by from three to four million acres annually as the cutting and burning of forests continue. The enormous area of forest land in the United States not required for any other economic use, estimated at four hundred sixty-three million acres, would provide an ample supply of wood if it were kept productive. Depletion has resulted not from using our timber resources but from failure to use our timber-growing land.

"The answer to the forestry problem of the United States is not to use less wood but to grow more—to put our idle acres of burned and logged-off timber land at work growing trees. This is not inherently a difficult thing to accomplish. It is not the Utopian dream of a technical enthusiast. Three-fourths of it lies in preventing forest fires. But it does require an aggressive national policy of reforestation. It requires concerted action by the national and state governments to do the things which must be done by public agencies. It requires the active participation of the private forest owner. It requires a clear definition of public and private responsibilities as to timber-growing land, with an equitable showing of the cost. There is no phase of our whole problem of an assured and perpetual supply of timber that cannot be met by simple and obvious measures once the constructive effort and capacity for organized co-operation of the American people are put behind them."

GREATER SUPPORT NEEDED

"If the Forest Products Laboratory is to be of the greatest possible assistance to the pulp and paper industry closer co-operation must exist with the mills, for the final test of any laboratory trial must take place in the mill," remarked Mr. Everest, in discussing several problems of the pulp and paper industry. "Too often information vital to the successful prosecution of a problem is withheld or full and hearty co-operation is lacking. If the mills refuse to give the laboratory their full confidence and at the same time maintain a critical and unsympathetic attitude but little real progress can be made on those problems in which the industry is vitally interested. If, however, they look upon the laboratory as a part of their own organization and treat it as such, correcting its mistakes and commending its successes, the greater portion of any research problem is already solved."

Mr. Everest spoke of the valuable assistance the laboratory is rendering in solving the manifold difficulties confronting the pulp and paper men in these days of decreasing supply of timber and increasing price of labor and the appliances of manufacturers. He believed that inadequate support was being given.

In conclusion he said: "We need this laboratory. Private enterprise cannot buy such facilities and conditions. You who have been privileged to see and know what is being done here must realize that if we are to solve our technical problems relating to timber, its care, perpetuation and proper use we must back this laboratory to the limit, either by inducing Congress to adequately provide for it or by individual subscriptions if necessary."

Prevention of Fires and Explosions in Coal-Tar Chemical Works*

BY NICHOLAS RICHARDSON†

THE problems for the fire prevention engineer in chemical works, and particularly in the synthetic dye industry, are new, peculiar and difficult, and it does not appear that expert chemical directors or advisers give sufficient attention to the accidents that may occur even in well-thought-out processes due to numerous causes which sometimes are foreign to the purely chemical nature of the operation. To one who has had opportunities of observing a wide range of operations and has particularly noted accidents occurring in many processes that were considered non-hazardous by men of experience, many features present themselves that are lost sight of by the man who has concentrated on a few lines only. Although a process may be non-hazardous in its normal operation, failure of mechanical devices to function properly, and unforeseen irregularity in the materials used, may result in hazardous conditions not contemplated.

The following remarks are quite apart from a question of insurance rate, or underwriting considerations, and attempt only to suggest lines on which may be worked out arrangements for reducing to a minimum the losses and interruption of business that may ensue from accidents in the particular operations. The most important is a rigid policy of so detaching and isolating all integral parts that the loss or damage in one will be localized and will not cause the interruption of production of the plant as a whole.

GENERAL DESIGN OF PLANT

Plant to be in units, each as small as practicable, separated and isolated from each other as efficiently as possible.

The vital points of the plant to be located in areas of absolute safety. The boiler and power plant, ice-making or refrigerating plant, the research laboratory with valuable records and the storehouse, where large amounts of finished products may be stored, are points of chief concern.

The location of processes shown to be especially hazardous to be considered with reference to other considerable values in plant and materials.

The location of above-ground tanks containing large quantities of flammable liquids to be considered with regard to the flow of liquid possible from leakage, rupture, etc. When tanks must be near buildings the consequences of falling walls should be considered.

GENERAL TYPE OF CONSTRUCTION

Buildings should be one story in height, and preferably of fire-resistive construction. It must be remembered that non-combustible construction does not necessarily imply fire-resistive qualities, and unprotected steel may have less fire-resistive quality than heavy timber.

The minimum of wall openings is recommended where separate buildings expose each other—blank walls are the most desirable—and necessary doorways should be protected with efficient fire doors.

The peculiar conditions of certain production buildings point to the advisability of light roofs, except over fusion kettles, etc.

In general it is recommended that the power plant, ice plant, research laboratory, fusion building and drying building be of strictly fire-resistive construction throughout; nitrating buildings, sulphonating buildings and grinding buildings to have fire-resistive walls and light non-combustible roofs, and other buildings to be of as good type of construction as the business warrants, slow burning wood construction for buildings where there are no manufacturing processes not being particularly undesirable.

OTHER POINTS TO BE CONSIDERED IN THE DESIGN OF A COAL-TAR CHEMICAL PLANT

In all buildings where benzol or toluol is used in any way, the floors should be above the surrounding ground level, without hollows or pits of any kind, and have ample ventilation openings at floor level to the outside. The vapors of these hydrocarbons are about three times as heavy as air and do not readily mix with moisture in the atmosphere. Floors of course should be of concrete, asphalt or some similar material. Such buildings must not be located in proximity to other buildings or plant where direct heat or flame is present, and the approach of locomotives must be avoided.

The floors of buildings where azo compounds may be present should be so adequately drained that the collection and drying out of dangerous salts is impossible.

The arrangement of storage tanks for benzol, toluol, fuel oil and other flammable liquids should be carefully considered. The most desirable arrangement is to have all storage below ground. Where above ground, the units should be of as limited capacity as practicable and dikes provided to confine escaping liquid from overflow, rupture, etc., to safeguard buildings, other tanks, wharves, etc., also to conserve the liquids themselves.

Gravity flow into buildings should be avoided.

Where air pressure lifting is necessarily used, the pressure egg should preferably be outside.

Heating arrangements for dealing with frozen benzol should be carefully designed to preclude the possibility of overheating.

Consideration should be given to safeguarding tanks containing flammable liquids against lightning.

The disposition of empty benzol or toluol drums which contain vapors should be considered.

The disposition of tank cars containing flammable materials is very important; the location of sidings where they are discharged or allowed to remain must be considered with regard to damageable property; the record of accidents with tank cars is very bad and too much care cannot be exercised in their use.

SPECIAL FEATURES IN MANUFACTURING

Nitrating. Nitrating benzol, toluol and other organic compounds is a very hazardous process; there are two important points of interest:

The first is the flammable nature of the material used. The vapors of benzol and toluol are heavy and have a considerable explosive range in mixtures with air; ignition is possible from many causes, among which are overheating, electrical power or lighting apparatus, static electrical discharges, and all may be guarded against.

The second is the danger of accident in the actual

*From a report submitted by the Underwriters' Bureau of New England to the Atlantic Dyestuff Co., Boston, Mass.

†Watertown, Mass., Arsenal.

nitration reactions, since failure of temperature control, stirring devices or regulations of flow of materials may have results that are of explosive violence, possibly followed by fire, difficult to control.

Nitrating, therefore, should be carried on in small buildings well away from other parts of the plant and be of non-combustible construction, but designed so that any explosion may be dissipated with a minimum of damage and the loss and interruption of work localized. All nitrating products must be considered as potentially dangerous. While the lower nitrated products may be considered safer than those of a higher degree of nitration, they cannot be considered safe, and in event of a fire even from an extraneous cause, conditions might arise from which explosion or uncontrollable fire would ensue.

Sulphonation. Sulphonation has dangers allied to the above and also due to material that may be treated. In case sulphonators need to be heated, indirect heat in all cases should be adopted; if direct heat from gas, fuel oil or other means is unavoidable, arrangements should preclude possibility of unequal heating and burning through.

Autoclaves. When processes involving use of autoclaves, with heat and great pressure, are used, autoclaves should be in special fire-resistive buildings, or at least in fire-resistive sections, properly cut off from other parts of the building. The dangers of accident with such apparatus have been shown to be great. When certain materials are treated the result of even a trifling accident may be disastrous.

Fusion. In this process, ignition of the contents of fusion kettles frequently occurs, and such apparatus should be in buildings of non-combustible construction.

Drying. Vacuum driers are at all times the most desirable, but where drying is done at atmospheric pressure, driers should be entirely of metal, or non-combustible material, and wooden trays or racks and paper should not be used in them. Drying buildings may often contain high values in nearly finished dyes, when a small fire from any cause may result in great loss of stock.

Grinding. In this operation there is often great hazard; dust may cause an explosive atmospheric condition, and possible igniting causes are many, such as foreign material, electric sparks, etc.; particularly is there danger at the end of a run. Some dyes may heat up in the mill owing to the incompleteness of certain previous reactions, and the grinding of all dyes with picramic acid base is attended with the greatest danger of explosion. Grinding should be done in a separate and small building, each mill should be isolated from others, and it is probable that some form of light non-combustible construction is most desirable.

Distilling. Stills are always liable to accident, and the magnitude of the resultant damage is largely dependent on the material being handled. They should be treated with the same regard to danger as nitrators. Direct fire-heated stills are, relatively, the most dangerous and their use should be avoided, or very rigid precautions taken.

Sulphur Colors. The manufacture of this class of dyes is very dangerous. Nitro and nitroso compounds are used, also sulphur and sulphides, involving the possible production of explosive or spontaneously ignitable substances.

When it is not known exactly what other dyes or intermediates will be manufactured, and also where it

is probable that changes and new processes will continually be introduced, it is recommended that a very careful review of all processes and reactions projected, and all materials used or produced, be given with a view solely to their fire hazards before the processes are put in operation.

Storage of Raw Material and Intermediates. The proper and safe storage of many raw and intermediate materials should have attention. Such compounds as picric acid, picramic acid, nitroso compounds, sulphides, chlorates, alcohol, etc., should each be in separate storages.

A storehouse divided into sections of small area by proper fire walls should allow the segregation of materials which may cause trouble due to careless handling, mixing with others, etc.

The storage of acids in tanks outside probably does not call for special attention, but the disposal of spent mixed acids from the nitration processes is important. Accidents have occurred due to nitrated, or unnitrated material, other than the acids, becoming mixed with them.

GENERAL MANAGEMENT

Accidents due to carelessness of employees are difficult to guard against. Smoking in all production or storage buildings should be rigidly prohibited. Owing to the difficulty of enforcing this rule it is suggested that a smoking room be provided in a safe location in the plant, where employees are even encouraged to go. It is also recommended that detached buildings be provided for locker rooms, and that employees be not allowed to leave their clothes or belongings in manufacturing buildings, or use driers for hanging wet clothing, etc.

Where processes are continuous, and night, Sunday and holiday work is necessary, it is often impossible to have the efficient supervision that obtains during usual day working hours, and records show that accidents are more liable to occur at these times. This is a peculiarity of the industry and has a great bearing on the hazards of the plant as a whole.

The foregoing remarks are largely directed from a prevention attitude, but an efficient system of fire-fighting apparatus, hydrants, and adequate water supply is assumed, in order that localization of fire may be assured.

Silk Production in Japan

The year just ended in May was one of the best for Japan's silk industry, owing to the prosperity in the United States and the lack of supplies from Europe, says the *Japan Times and Mail* for June 7, 1920. The export figures from June, 1919, to May 31, 1920, reached 517,311 bales, an excess of 50,305 bales over the previous year. The previous largest figure was less than 500,000 bales.

The silk production of the country has attained a remarkable development during the past few years, especially during the war period, in which the world's demand for silk yarns was centered on the Japanese market, owing to the decline or stoppage of the sericultural industry in Europe. Though the sudden depression of the business caused by the financial failures toward the closing part of the silk year dealt a severe blow to the trade, the production for the season was still a record.

The Power Problem in a Copper Refinery

An Outline of the Steam Recovery Possible With Waste Heat Boilers and the Steam Demand for Heating Electrolyte, With a Discussion of the Bearing of These Factors Upon the Problem of Choice of a Prime Mover

BY LAWRENCE ADDICKS

AN ELECTROLYTIC copper refinery may obtain its power from a self-contained steam or gas plant, from an adjacent water power or by transmission, but while each case will call for a different type of power plant as far as the provision of current for the tanks is concerned, the demand for fuel for smelting and for steam for heating liquors will remain unchanged. The fact that both fuel and steam are required introduces waste heat boilers in any event and most refineries have steam-driven electrolytic generators, although there are notable exceptions. The conditions surrounding each case call for individual study of all the factors entering and it is the purpose here merely to point out the general requirements and limitations of the problem as a whole.

In the early plants, before the days of waste-heat boilers and with live steam heating, the total water entering the plant could be considered as utilized as roughly one-third for generation of electrolytic power, one-third for steam for heating and miscellaneous uses and one-third for make-up water in the tanks and at the boshes. The ideal steam-driven plant would, therefore, be one where the steam generated by waste heat at the reverberatories would be sufficient to supply the demands of the engine room, the exhaust from the engine room used for heating and the condensate finally used as make-up water at either the boshes or the boilers. This ideal solution is yet far from being reached, but the very uniform conditions of load and output under which a refinery is run have enabled sufficient progress to be made in this direction considerably to handicap hydro-electric and gas plant competition.

WASTE HEAT BOILERS

It is perhaps most logical to start with the consideration of the amount of steam available as a by-product at the reverberatories.

Given a fair grade of bituminous coal, a modern refining furnace will average eight to nine tons of product per ton of coal burned. As there are two furnace operations and as the anode furnace treats about 15 per cent of anode scrap and as various other items contribute to swell the net tonnage treated in either furnace, a ratio of four to one is safe, giving 25 per cent fuel consumption on a cathode basis.

A properly designed boiler, placed close to the throat of the furnace and equipped with an economizer, can be depended upon to give an average equivalent evaporation of between 6 and 7 lb. of water per lb. of coal fired. We, therefore, have available about 1.5 lb. of steam per lb. of cathode output, or in other terms a 200-ton furnace will develop at least 363 boiler horse-power.

The rate of steaming is not uniform, as although the coal in a large modern furnace is consumed quite

steadily throughout the twenty-four hours, the two extremes of poling and charging give large differences in the temperature of the gases leaving the furnace. The situation is graphically expressed in Fig. 1. Where a number of furnaces are feeding boilers in parallel, their operations are usually staggered enough to give a sufficiently uniform steam supply to avoid any serious irregularities in the demand upon the main boiler installation. Where the electrolytic power is obtained by transmission, this variable supply might cause undesirable fluctuations, but in this case most of the steam would be used for heating purposes where considerable

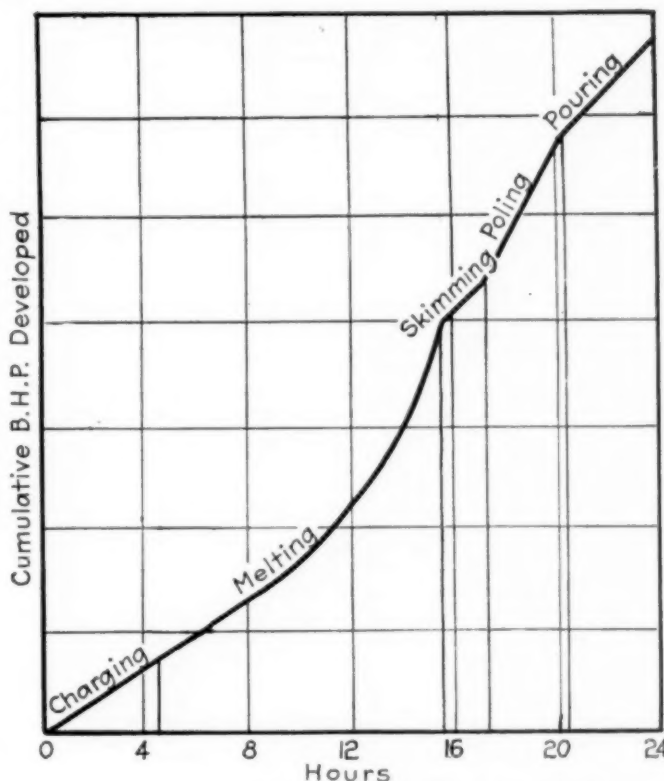


FIG. 1. WASTE HEAT BOILER STEAMING RATE

variations are temporarily permissible. On Sundays the waste heat steam supply is lessened, but so is the miscellaneous demand.

A good general discussion of the whole question of waste heat boiler equipment is given in a paper by Arthur D. Pratt in the *Transactions* of the A.S.M.E. for 1916, vol. 38, p. 599, and of the particular application to copper refining furnaces in an article by Clarence L. Brower in the *Engineering and Mining Journal* for May 22, 1915, vol. 99, p. 892. The secret of successful operation lies in placing the boiler as close as possible to the furnace throat and in the exclusion of air infiltration. A good modern installation obtains a temperature of 1,600

to 1,700 deg. F. in the boiler firebox as against 1,000 to 1,200 deg. in the earlier attempts. The exit gases may be brought down to 500 or 600 deg. F.

ELECTROLYTIC POWER

As has been discussed in a previous article (MET. & CHEM. ENG., March 15, 1917), the power required in the tank house depends upon the current density and the temperature of the electrolyte. In average practice the density will be around 18 amp. per sq.ft. and the temperature about 130 deg. F., in which case the power con-

ing work as far as power generation is concerned. The great first cost of the installation and its low economy at partial loads have always been handicaps. The history of refineries has been that they are continually being added to and expanded and that even individual units are seldom operated under the conditions for which they are designed, while above all else a gas plant lacks elasticity. On a basis of thermal efficiency some very interesting figures may be worked up, but very large steam turbine units can now practically equal these.

As between steam turbines and reciprocating engines, the question is largely a question of size of unit. A turbine can expand steam down to the highest attainable vacuum without unreasonable increase in size and owing to its high rotative speed very large units can be built in small compass. In the case of a reciprocating engine the speed is limited by valve gear considerations, while cylinders larger in diameter than 54 in. are undesirable and the practical limit of size is about 72 in. diameter by 72 in. stroke. The low pressure cylinder is frequently divided into two in making a four-cylinder triple-expansion unit. These considerations bring us to about 2,000 hp. discharging into 27½ in. vacuum as a reasonable limit size of unit for a reciprocating engine and the steam economy attainable

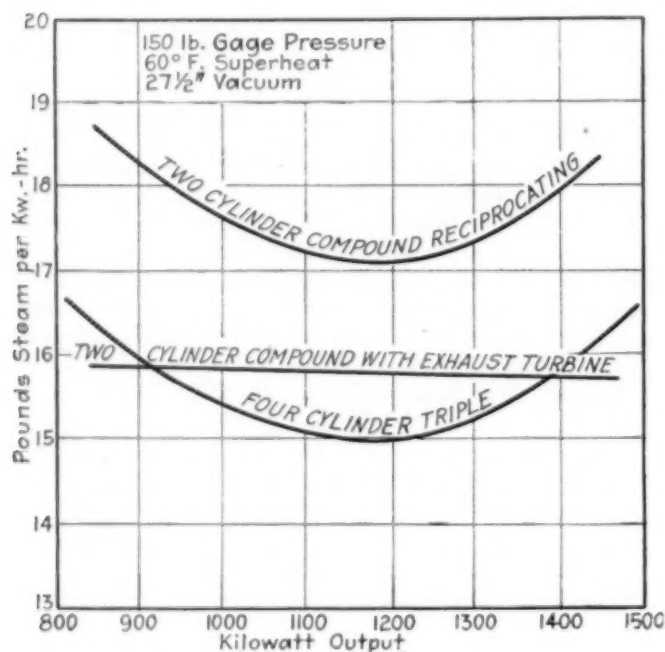


FIG. 2. WATER RATE PER KW.-HR. ON 1,200 KW. UNIT

sumption will approximate 350 kw.-hr. per ton of copper deposited. In general a refinery with a capacity of 100,000 tons a year may be considered large enough to be a thoroughly economical unit and this would call for a dependable power capacity of about 4,000 kw. Whatever type of steam-driven prime mover be adopted, a thoroughly modern power plant of this size should deliver a kw.-hr. at the switchboard for not over 15 lb. of steam, given reasonable superheat and vacuum and excluding auxiliaries. We, therefore, require at the throttle roughly 2.6 lb. of steam per lb. of copper refined, or nearly double the 1.5 lb. available from the waste heat boilers.

CHOICE OF PRIME MOVER

In cases where water power is cheaper than steam at the place where a refinery has been located, generally for reasons quite apart from the cost of power, it is of course employed, and we have such a case in the refinery at Great Falls, Mont. In the same way transmitted power originating at a water power is used at Tacoma and to a certain extent at Baltimore. A very unusual instance of power transmitted from a steam generating plant is that of the electrolytic department of the leaching plant at Chuquicamata, Chile. In general a refinery is located with reference to copper freights rather than cost of power and in most locations steam power is cheaper than water power.

Gas power has also been more or less discussed, but up to the present time nowhere applied to copper-refin-

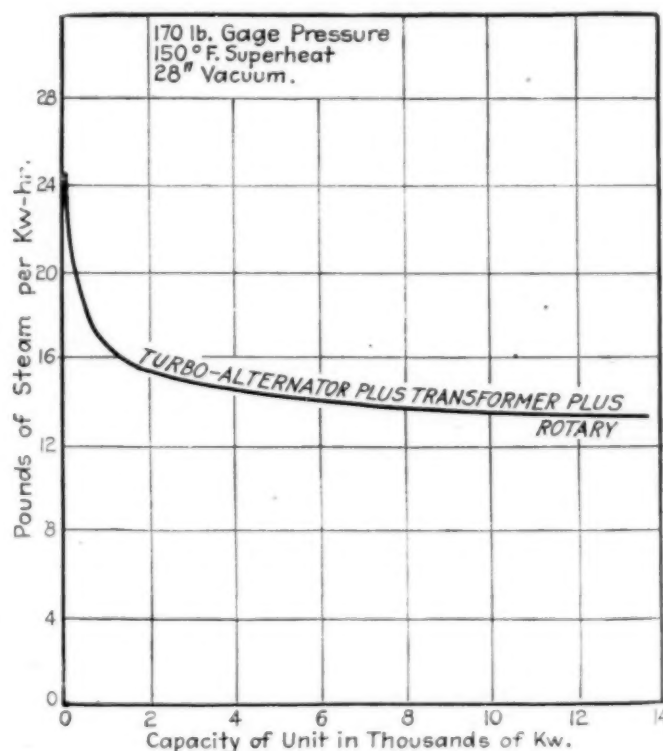


FIG. 3. APPROXIMATE STEAM TURBINE WATER RATE

is indicated in Fig. 2. A turbine of this size can hardly equal this performance even with higher vacuum and when the efficiencies of conversion from alternating to direct current are included it is under a serious handicap as far as economy of steam consumption is concerned. In larger sizes, however, the turbine reaches very high economy. Fig. 3 shows approximately what water rate may be expected with 170 lb. gage pressure, 100 deg. F. superheat, 28½ in. vacuum, after allowing 7 per cent loss of a.c.-d.c. conversion. (See Stott, quoted below.)

The advantages of a turbine are based partly upon its compactness and its ability to utilize high superheat and vacuum. One inch of vacuum or 50 deg. F. superheat will vary the water rate 5 or 6 per cent in a high pressure turbine. As to the space factor, it must be remembered that its value is considerably less at a refinery than in a city power house and regarding condensation the cost of producing high vacuum must not be lost sight of. The temperature of saturated steam drops very rapidly as vacuum increases and if cold water is not available the cost of circulating water may become very great. These conditions are illustrated by the curves in Fig. 4.

The whole question of the relative value of the several types of prime mover is reviewed by Stott, Pigott and Gorsuch in *Transactions, A.I.E.E.*, vol. 33, p. 1,133. The special application to electrolytic work was discussed at a joint meeting of three of the engineering societies several years ago and may be referred to in the various transactions as follows: Newbury, *Trans., A.I.E.E.*, vol. 33, p. 1; Longwell, *Journal, A.S.M.E.*, July, 1914; Addicks, *Trans., A.E.S.*, vol. 25, p. 65. In a general way it can be stated that with cheap coal the plant will be steam driven, using reciprocating engines if small and turbo-alternators distributing through rotary converters if large. With expensive coal, a fairly large plant and regular tonnage a gas plant could be made to pay. With water power close at hand it would probably displace either steam or gas.

THE ELECTRIC GENERATOR

The tank house circuits demand (a) direct current, (b) high amperage, (c) low voltage and (d) wide voltage range. The amperage used has steadily increased as the generator builders have found it possible to build larger capacity commutators and to-day runs between 10,000 and 15,000 amp. per circuit. The voltage is generally limited to 200 volts or less per circuit and the maximum unit to be considered is, therefore, 3,000 kw., while 10,000 amp. at 120 volts or 1,200 kw. would more nearly represent present practice. A 1,200-kw. generator, direct connected to a reciprocating engine, would call for 1,900 i.hp., which is about the limiting engine size.

The generator problem is almost wholly one of commutation. This subject is reviewed at length under the heading of "Physical Limitations in D.C. Commutating Machinery," by B. C. Lamme, *Transactions, A.I.E.E.*, vol. 34, p. 1,739. The simplest case is that of the direct connected reciprocating engine. Here the slow engine speed, certainly not over 125 r.p.m., permits reasonable freedom in commutator design, and the volts per segment, length of bar and amperes per brush arm can all be placed at conservative figures. It must be remembered that steady duty at 100 per cent current load and occasionally at abnormally low voltages imposes commutating conditions far more severe than met with in average practice and that any roughening of the commutator surface becomes rapidly worse. Commutating pole field construction has made a great advance toward sparkless commutation in all electrolytic generators.

The efficiency of a direct connected engine type generator exclusive of bearing friction will be about 94 per cent and the e.hp. delivered by the generator should be about 88 per cent of the i.hp. of the engine. The total losses on a 750 kw. C-W. generator built in 1905 are given in Table I.

The direct current steam turbine has also given satis-

Voltage	Volts.....	125	125	100
Current	Amperes.....	0	6,000	9,500
Output	Kw.....	0	750	950
Bearing friction	Watts.....	4,000	4,000	4,000
Windage	Watts.....	1,600	1,600	1,600
Brush friction	Watts.....	6,200	6,200	6,200
Core and pole losses	Watts.....	18,000	18,500	15,000
Field copper	Watts.....	6,560	7,930	4,680
Armature copper	Watts.....	11,750	11,750	29,400
Brush resistance losses	Watts.....	8,650	8,650	15,400
Total losses	Watts.....	36,360	58,630	76,280
Mechanical losses	per cent input.....	32.4	1.5	1.1
Magnetic losses	per cent input.....	49.4	2.3	1.5
Electrical losses	per cent input.....	18.2	3.5	5.0
Output (efficiency).	per cent input.....	0	92.7	92.4
Load	per cent rating.....	0	100	127

faction in service, although there is a practical limit to the size of commutator which can be constructed, as it is necessary to restrict the diameter owing to the high rotative speeds required. A two-cylinder compound driving a direct connected generator and exhausting into a direct-current turbine connected electrically in parallel makes a satisfactory unit and several such pairs are in successful operation. The steam economies

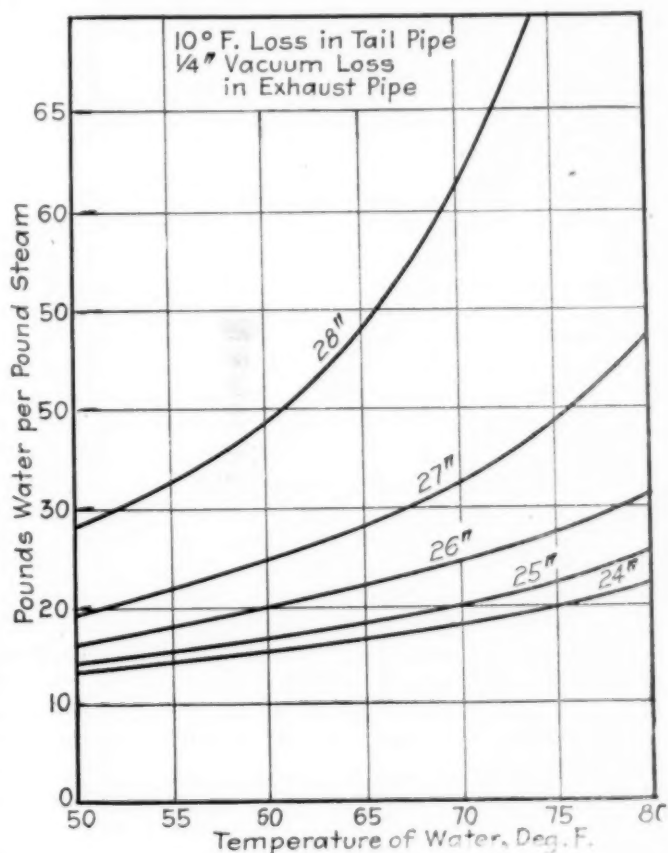


FIG. 4. WATER REQUIRED FOR CONDENSING

possible with such combinations are indicated in Fig. 2. This same field is covered by geared units, a rather high-speed generator being geared to a rather low-speed turbine. For large plants electrical rather than mechanical connection between turbine and generator, as provided by rotaries, has many advantages.

The unipolar generator which delivers direct current without a commutator and which may be driven at turbine speeds is a very pretty theoretical solution of the whole problem. Practically, while commercial units have been built (see Lamme, *Transactions, A.I.E.E.*, vol. 31, p. 1,811), many special problems are involved

in the collection of the current, and this type of apparatus has not received any considerable application.

If a turbo alternator is used as the main source of current, allowance must be made for the efficiency of the distributing system, the transformers, conductors and rotary converters absorbing about 7 per cent of the a.c. output.

The voltage regulation should be made wide and is satisfactorily accomplished by hand control. In the case of reciprocating engines the speed may be altered so as to keep the engine operating at the best cut-off. This, however, means some adjustable attachment to the engine governor, which has its drawbacks. With ordinary direct current generators, either engine or motor driven, the usual hand rheostat gives satisfactory voltage control and modern commutating pole generators will operate well at surprisingly low voltages. In the case of rotary converters it is necessary to use booster control on the alternating current side, which may be supplemented by employing multi-tap transformers.

A circuit of 120 volts would probably have 360 tanks connected in series and when drawing copper two groups of, say, thirty-six tanks each might be cut out. This would call for a 20 per cent cut in the normal operating voltage during this period. On the other hand, while a tank house is supposed to be operated on a constant current basis, this is very apt to become constant wattage, the current density being temporarily increased during periods of low voltage.

HEATING ELECTROLYTE

Heating the electrolyte has already been discussed (MET. & CHEM. ENG., March 15, 1917). At what temperature it will pay to carry the liquor must be determined for each case. Eastern refineries expend about 0.75 lb. of steam per lb. of copper produced to raise this temperature, say, 30 deg. F. This means a power saving at the generator of 15 per cent taking an overall temperature coefficient of 0.5 per cent per deg. F. If we are using 3.0 lb. of steam (including auxiliaries) per lb. of copper at the engines the saving will be 0.45 lb. as against 0.75 lb. required at the heating coils and it is evident that live steam heating would not pay. If we run an electrolytic unit non-condensing it will take about 4.0 lb. of steam instead of 3.0. If we are able to run a proper proportion of the circuits non-condensing we can, therefore, furnish steam for heating the tanks and obtain an average overall steam rate of 3.2 lb. on 85 per cent of the original resistance, or 2.7 lb. per lb. of copper instead of 3.0 when running without heating.

Where the electrolytic power is hydraulic live steam heating may not pay if there is not waste heat boiler capacity in excess of other needs, but except where very high densities are employed, thereby predicating clean bullion and resulting in considerable electrical heat being generated in the tanks, it generally is desirable to heat the electrolyte from purely metallurgical considerations.

The condensate from heating coils is generally collected for use in washing the anodes and cathodes free from slimes, bluestone crystals, etc., and a small amount of heat is in this way returned to the system as well as a safeguard established against leaky heating coils withdrawing any electrolyte and sending it to the sewer.

The silver refinery and the purifying system or bluestone plant will always require a certain amount of boiling or evaporating. This varies greatly in amount

in different plants. In a very general way it may be stated that there will be 2 lb. of steam condensed for every pound of water evaporated and that about 10 per cent of the total steam used will be employed in this way in the average plant.

Steam siphons used for pumping are really heaters, their efficiency as pumps running but a few hundredths of 1 per cent. The steam consumption of a siphon depends upon the original design and upon the amount of nozzle wear at the time of test, but 1 per cent dilution of the liquor is probable and 3 per cent possible.

HEATING FEED WATER

The steady full load conditions of the electrolytic engines call for a complete installation of economizers. Probably 10 per cent of the steam furnished by the boilers will be called for as exhaust steam for further heating of the feedwater.

MISCELLANEOUS DEMAND

There is a considerable amount of pumping to be done, such as circulating electrolyte, circulating bosh water, supplying condensers, fire system, general water supply, feeding boilers and high pressure system for hydraulic cylinders. There is a more or less extensive compressed air system for operating copper hoists and pneumatic tools. There is power required for the motor drives of cranes, shop tools, ventilating fans, sampling drills and possibly an electric railway. Finally there is the lighting system.

If steam driven, non-condensing, in a large plant, these various units will consume from one-third to one-half as much steam as is called for by the electrolytic generators operated condensing. This steam may advantageously be turned into the heating systems, the requirements of which it roughly fills, turning all of the electrolytic exhaust into the condenser. Another solution is to electric drive all auxiliaries and supply the current by means of a non-condensing light and power unit. There is even the opportunity of utilizing an electrolytic spare for this service, thereby reducing the total equipment called for, the plant consisting of several electrolytic generators, one light and power unit and one spare for both services.

SUMMARY

The total steam consumption of a copper refinery will vary within wide limits, depending upon the size of

TABLE II		lb. steam per lb. copper.
A.	Electrolytic power, condensing.....	2.5 to 3.0
B.	Light, power, water, air and auxiliaries, non-condensing.....	1.0 to 1.5
C.	Evaporating, live steam.....	0.5 to 2.0
D.	Heating, exhaust steam.....	1.0 to 1.5
E.	Total steam demand, $A + B + C + D$	5.0 to 8.0
F.	Exhaust steam for D from B.....	1.0 to 1.5
G.	Contributed by waste heat boilers.....	1.5 to 1.5
H.	Net steam demand, $E - (F + G)$	2.5 to 5.0

plant, the current density employed and the amount of purifying of the electrolyte required, and may be stated somewhat as in Table II.

China's Soap Trade

Although many small native soap factories, producing cheap and inferior soaps from local raw materials, have recently sprung up in various parts of China, for many years there has been an increase in China's import trade in this commodity as a result of the growing use of soaps by the Chinese.

Forest Products of the Northwest as Industrial Chemical Assets

BY R. K. STRONG

AT PRESENT the great industry of the Pacific Northwest is that of lumbering. One-fifth of the standing timber of the United States is in Oregon, and consists mainly of Douglas fir. The byproducts of this industry form a large potential source of raw materials for the industrial chemist.

It is a matter of considerable expense to dispose of the waste wood and sawdust produced at the sawmills. Within the last few months one concern has put into operation a 90-foot incinerator, said to have cost \$50,000 to erect. Except near the cities, most mills burn the waste in this way, to prevent its accumulation forming a nuisance. In the forest the stumps are difficult to remove on account of their immense size and the length of time required for decay. The trimmings of the trees form a considerable fire hazard.

WASTE WOOD UTILIZATION

In the cities much of the waste wood is used as domestic fuel. An appreciable percentage of the sawdust and least valuable waste is utilized in this way for the production of power. Three large plants in Portland use such fuel in the generation of electricity. A large paper mill is being constructed in which much fuel will be obtained from a neighboring lumber mill, in return for which electricity is furnished the latter.

In considering the chemical uses to which waste wood may be put two lines of procedure are available—namely, those in which the material must be dried at some stage in the process, and those in which the waste is utilized by wet methods. On account of the large moisture content, which may be over half the gross weight, and the difficulty and expense involved in removing the same it would seem that processes operating without the necessity of removing the water would be more likely to succeed if other considerations were even approximately equal.

METHODS INVOLVING VOLATILIZATION OF WATER

As a fuel, wood waste and sawdust have inherent drawbacks, such as the high moisture content mentioned above and the low calorific value when dry. It is stated that the fuel value of a cord of wood on the dry basis is 20 per cent less than that of a ton of coal. The combustion space is necessarily larger and the flame temperature lower than with coal. In spite of these disadvantages the fuel gives satisfaction for steam generation. Plants for the production of fuel gas from wood are in operation, and it is expected that more will be installed.

Considerable work has been done on the destructive distillation of Douglas fir. As it has not yet proved successful on a large scale, probably on account of the low yield of valuable products, the problem is open.

WET METHODS

The wet methods available for treating wood waste center around the production of paper pulp and seem to offer every promise of ultimate success, if attacked with the proper scientific and financial backing. Either with or without preliminary steam distillation for the recovery of the turpentine content, the wood can be made into a satisfactory pulp for certain grades of

paper by the soda or sulphate process. Experiments here have shown a high cellulose content in Douglas fir. The Forest Products Laboratory, at Madison, Wis., states the yield, in experiments made there, to be 1,170 lb. of bone dry, screened, unbleached pulp per 100 solid cubic feet of wood—the equivalent of one cord as ordinarily piled. The report states further that the fiber is of good length and the kraft pulp of good grade, with uses similar to that made of white spruce.

An approximate idea of the amount of pulp it is possible to recover from waste wood may be obtained from the statement that about 25,000 cords of waste wood, not including sawdust, are produced per month on the harbor front of Portland alone—a location which offers excellent facilities for utilization of this material both as to quantity available and transportation advantages. Even if only half of this were used, a production of 5,000 tons of paper pulp per month could be obtained.

Another wet process is that by which wood sugar is made for use in the manufacture of ethyl alcohol. Considerable importance attaches to this product in regard to its use as a fuel for internal combustion engines. Canada is attacking the problem in a large way.

OTHER WOOD PROBLEMS

Minor problems that are worthy of study and full of promise are the extraction of tannin from the bark of the Western hemlock and the Douglas fir, and the recovery of rosin and turpentine from forest waste and stumps. Douglas fir pitch is receiving attention as a source of turpentine and rosin oil, the pitch being drawn from pockets caused by wind shakes.

PAPER PULP

The amount of paper pulp at present produced in the Pacific Coast region is relatively small, although the mills already established are intelligently operated and of good size. From the latest statistics of the Forest Service, for the year 1918, the following figures are cited to compare and contrast the production of paper pulp in the Eastern and Western states:

EASTERN STATES			WESTERN STATES		
State	Cords Pulp Wood Consumed	Per Cent of Total in U. S.	State	Cords Pulp Wood Consumed	Per Cent of Total in U. S.
Maine.....	1,235,000	23.5	Oregon.....	240,000	4.6
New York.....	1,004,000	19.1	Washington...		
Wisconsin.....	861,000	16.4	California.....		
Pennsylvania...	384,000	7.3			
New Hampshire...	345,000	6.6			
		72.9			4.6

Total consumed in the United States, 5,251,000 cords.

The output of the Pacific Northwest should be greatly increased and the percentage raised to an appreciably large fraction of the production of the country. This could be done with more benefit to the country and at less expense than the proposed utilization of the Alaskan forests for this purpose. Not that the latter is undesirable, but that the former can be more easily and quickly accomplished.

Research and development would make possible the use of other woods of the region besides those at present made into pulp. With 46 per cent of the standing timber of the United States in the Pacific Northwest and an abundant supply of water for power and pulp treatment, there should be a paper-producing industry in this region ranking with that in any other part of the country. Research and capital can accomplish this in a reasonable time.

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Zones of Weakness in Solidified Ingots

BY LESLIE AITCHISON, D.MET.

IN THE course of a considerable experience of the defects which are met by engineers in bars, forgings and castings made of steel and other metals I have been convinced that a very considerable proportion of these defects can be traced back to the earliest history of the metal; namely, to the form which it assumes immediately after it has been melted and poured from the melting furnace. In other words, it can be said quite definitely that a very large number of the engineer's problems are created for him in the steel or brass ingot which provides the metal which he finally uses. This being so, it seems desirable to give a brief account, as far as possible, of some phenomena associated with the production of metal ingots.

Columnar crystals will fill up the whole of an ingot if the supply of fluid metal does not fail or if the growing crystals do not meet any solid obstruction. The first requisite means that the metal in the ingot must remain liquid for a comparatively long time. In practice it may happen in relatively small ingots that the steel in the center of the ingot remains fluid to the end, but in large ingots this very rarely occurs, and the center of the ingot is cooled down to the freezing point before the columnar crystals have grown right across the ingot. The solidification of the remaining metal takes place from a large number of independent centers, the result being that the center of the ingot is filled up with numerous small crystals of no special shape and whose axes do not lie in any definite direction in relation to the walls of the ingot mold. These may be termed "free" crystals. The main variation among the different steel ingots is the proportion of the columnar and "free" crystals found therein. From what has been said above one important factor which determines the proportion of these crystals is evidently the temperature from which the metal was cast, as this will fix the time during which the steel will remain fluid after casting.

SETS OF CRYSTALS DISTINCT AND SEPARATE

The structure of the cross-section of an ingot shows the way in which two sets of columnar crystals growing from adjacent sides of the ingot mold interfere along a plane of junction. It is quite clear that the two sets of crystals are quite distinct and separate and that even where they touch they do not join or coalesce. If the junction has been suitably magnified for examination the nature of the junction is made much more plain and it is evident that really there is no junction at all, there being rather a complete discontinuity or hiatus between the two sets of crystals. If this is so it may be expected that between the individual columnar crystals (which after all have formed their junctions in exactly the same way in which the junction of the sets of columnar crystals has been formed) there will be no real coalescence. Similarly there will be a zone in which the columnar crystals of the outside of the ingot join onto the free crystals of the core, and here again there will be distinct discontinuity or lack of cohesion between the two constituent types of crystal.

It must be stated that in the majority of cases the crystal boundaries, particularly those of the columnar crystals, are defined by a layer of non-metallic impurities—slag or sulphides or the like. Conversely it may

be put that if there is a layer or a pocket of non-metallic material in the ingot it will result in a greater or less degree of discontinuity between the crystals around which it is formed.

POSITION OF NON-METALLIC IMPURITIES PREORDAINED

In the middle of the ingot—i.e., in the free crystals of the core—there are found a certain number of places at which there are inclusions of non-metallic impurities. It can easily be understood that these inclusions will occur somewhere, and a little thought will show that the positions in which they are found are more or less preordained. As the steel rises in the mold the steel in contact with the sides and bottom freezes first and the succeeding layers of steel to solidify will be more or less cup shaped. Owing to fluid contraction and to the contraction which occurs during the plastic state of the metal in the core of the ingot there is a tendency for the steel of any particular layer to sink in the middle to a level rather lower than that at the sides, so that a layer which was originally horizontal becomes at a later stage more or less sharply depressed in the middle. The result is that the successive layers of steel as they solidify are distorted downward. The non-metallic inclusions will follow the same path, so that the region filled with free crystals—i.e., the part of the steel which was fluid longest—contains these inclusions arranged symmetrically pointing downward and inward toward the central axis of the ingot. Since the inclusions are there it is safe to assume that there is some discontinuity between the crystals at these points.

SUMMARY

Summing up, it is evident that in the solidified ingot there are certain definite zones in which there is only very moderate cohesion between the crystals of the steel, and consequently that these positions in the ingot are zones of weakness. The zones in particular are: (1) the junction of each columnar crystal with its neighbors. (2) The junction of each set of columnar crystals. (3) The junctions of the columnar and the free crystals. (4) The symmetrically placed "herringbone" arrangement of planes of non-metallic impurities lying on either side of the axis of the ingot. These four places, since they represent the weakest zones of the ingot, are the positions at which contraction is likely to take effect. The result of the contraction will be the pulling apart of the hotter crystals within the ingot from each other and from the cooler, more rigid and stable shell, thus producing contraction or cavities in the metal. The pulling apart of the columnar crystals either individually or in sets may easily occur in the early stages of the contraction—i.e., during the later stages of solidification—while the later contraction will become evident in the junction of the columnar and free crystals and in the "herringbone" cavities within the free crystals.

Unfavorable Outlook for German Potash Industry

The issue of *Deutsche Allgemeine Zeitung* for June 16, 1920, says that at the general meeting of the Bergbau-Aktien-Gesellschaft Justus in Volpriehausen the chairman remarked that domestic sales had come to a complete standstill. No exports are being made to the United States at present. Negotiations with the Americans are still pending, but the Potash Syndicate expects to come to a satisfactory settlement and to resume deliveries in the near future.

Studies in Evaporator Design*—II

The Effect of Temperature Drop and Temperature Level on Heat Transmission in Vertical Tube Evaporators—Corrections for Hydrostatic Head—Boiling Points, Heat Drops and Steam Temperatures as Factors†

BY W. L. BADGER AND P. W. SHEPARD

DETAILS of the methods used in conducting the tests and making the measurements have been given in Part I.

Pressures were measured in mm., temperatures in deg. C., and heat in kilogram calories. Where condensed water was weighed, it was weighed in pounds. When measured, it was calculated directly in kilograms. Heating surface was calculated on the basis of the wet surfaces. Both top and bottom tube sheets were included. The heating surface in tubes was 65.4 per cent of the total, the rest being in the basket shell.

Heat input was taken as the sum of the latent heat at the temperature calculated from the pressure of the steam basket, and the sensible heat recovered between this temperature and the temperature of the condensate. All calculations from the simplest up were made independently by two persons and checked back. All figures in the calculations were carried to 0.01 deg. for temperatures, 0.1 mm. for pressures, 0.1 kg. for weights and 0.1 cal. for heat. The final results were rounded off to the nearest even digit for K .

RESULTS

The essential data for the three series of experiments are given in Tables II, III and IV and in Fig. 3. It will be noted in the tables that the results are averaged in groups. In Fig. 3 the average of each group is indicated by a large circle. These circles have their centers at the exact points indicated in the averages and their radius is fifty units on the scale for K . This is an arbitrary choice, but is thought that it represents approximately the accuracy of the averages. At any rate there are few cases where it is possible to suppose that the average has a greater accuracy than this.

The principal thing which the curves indicate at once is the decided effect of both temperature level and temperature drop. The curves cannot be represented by a simple equation and it has not been thought worth while to try to derive any expression for them, in view of the limited significance of the absolute numerical values.

The large number of determinations on the 25 deg. point on the 75 deg. curve is due to the fact that this point is common to several sets of investigations now under way. The theoretical work of the station has been interrupted at numerous times. After each interruption this point was redetermined in order to be certain that the evaporator was in a condition similar to that under which the other runs had been made. No definite explanation can be made now for the fact that the 20 deg. point on the 75 deg. curve is low.

In order to get a basis for more general comparisons, these figures were all corrected for hydrostatic head.

The points corrected were not the averages actually determined, but were read off the smooth curves. The method of recalculation is illustrated by the following example:

Let t_g = temperature of steam (calculated from pressure).
 t_w = temperature of boiling liquid at the surface (calculated from vacuum).
 t_b = temperature of boiling liquid at the bottom tube sheet.
 $\theta_1 = t_g - t_w$ = temperature difference at surface = "apparent" temperature drop.

$\theta_2 = t_g - t_b$ = temperature difference at bottom.

$\theta_{mh} = \frac{\theta_1 + \theta_2}{2}$ = mean temperature difference corrected for hydrostatic head.

P_g = absolute pressure in vapor space.

P_h = head of liquid on bottom tube sheet in mm. mercury.

$P_b = P_g + P_h$ = total pressure at bottom tube sheet.

For example, take the 25 deg. point on the 75 deg. curve.

$P_g = 287.6$ mm. $t_w = 74.89$ deg.

$t_g = t_w + 25.00$ deg. = 99.89 deg.

$\theta_1 = 25.00$ deg.

The hydrostatic head is 48 in. of water at a temperature of about 75 deg. (sp gr. of water at 75 deg. = 0.9749).

$P_h = \frac{48 \times 25.4}{13.6} \times 0.9749 = 87.4$ mm.

$P_b = 287.6 + 87.4 = 375.0$ mm., $t_b = 81.37$ deg.

$\theta_2 = 99.89 - 81.37 = 18.52$ deg.

$\theta_{mh} = \frac{18.52 + 25.00}{2} = 21.76$ deg.

Now from the curve we read the apparent K at $\theta_1 = 25.00$ deg. as 2,240.

Then the corrected K is $2,240 \times \frac{25.00}{21.76} = 2,573$ cal.

The complete data from such calculations are given in Tables V, VI and VII and are plotted in Fig. 4, to which the curves for apparent K are added for comparison.

NOTES ON CALCULATIONS

This method of calculation calls for boiling points higher than steam temperature for the 5 deg. and 10 deg. points on the 60 deg. curve and for the 5 deg. point on the 75 deg. curve. These cases were handled as follows: The point on the basket where the boiling point of the liquid should become equal to the temperature of the steam was determined. At this point, then, the true temperature difference should be zero so far as any boiling is concerned. The mean temperature difference over the part of the heating surface used for boiling was taken as the arithmetical mean of zero and the temperature difference at the top. Assuming that the heating surface below this point was totally inactive, the apparent values for K were recalculated on the basis of the new temperature drop and the diminished heating surface. For the sake of comparison this correction was also made on the basis of temperature drop only, neglecting any consideration of decreased heating surface. Both values so obtained are plotted for each of the three points in question.

It will be seen that neither assumption was correct, but that the truth lies somewhere between the two. The values calculated on the basis of no action in the lower part of the heating surface are too high, thus

*Read before the American Institute of Chemical Engineers, Montreal, June 27, 1920.

†For Part I, see CHEM. & MET. ENG., vol. 23, Nos. 6, Aug. 11, 1920, p. 237.

TABLE II. DATA OF INDIVIDUAL RUNS

60 Deg. Temperature Level										
I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Run No.	Time Min.	Mm. Hg.	Absolute Body Pressure, P_b Deg. C.	Corres. Body Temp., t_b Mm. Hg.	Absolute Steam Pressure Mm. Hg.	Corres. Steam Temp., t_s Deg. C.	Condensate Temp. Deg. C.	Condensate Lb.	Apparent Temp. Difference θ_1 Deg. C.	K U
183	60.0	145.9	59.56	186.2	64.87	64.39	68	5.31	516	104
44A	60.0	145.8	59.55	193.2	65.68	65.05	87	6.13	570	117
179-II	60.0	134.8	57.88	186.8	64.93	64.75	125	7.05	713	153
181-II	50.2	143.7	59.24	192.9	65.65	65.22	101	6.40	760	155
178-II	15.25	136.1	58.08	216.5	68.26	67.02	164	10.18	773	158
178-III	40.25	137.1	58.24	214.9	68.09	66.84	116	9.85	709	145
184	50.0	138.5	58.45	208.3	67.38	66.36	138	8.93	743	161
185	50.2	138.9	58.51	208.9	67.44	66.43	162	8.93	872	179
186	50.0	139.9	58.66	210.6	67.62	66.50	124	8.96	670	137
61B-I	42.5	138.6	58.47	217.2	68.34	65.81	157	9.87	899	183
61B-II	30.0	140.3	58.73	219.8	68.61	66.37	122	9.88	998	204
61B-III	30.0	140.2	58.71	216.7	68.28	65.28	110	9.57	922	189
50B-I	31.5	141.2	58.86	276.5	73.79	71.93	264	15.09	1,334	273
50B-II	31.0	141.2	58.86	277.3	74.01	72.36	278	15.45	1,417	290
177-I	30.8	137.7	58.33	272.5	73.60	71.61	246	15.27	1,254	257
177-II	30.67	137.5	58.30	271.0	73.47	71.71	244	15.17	1,260	258
177-III	30.08	139.1	58.55	273.7	73.70	71.71	230	15.15	1,208	248
51B-I	30.0	145.5	59.51	347.1	79.43	76.51	401	19.92	1,603	328
51B-II	30.0	145.5	59.51	345.9	79.35	75.91	386	19.84	1,551	318
51B-III	19.5	145.4	59.51	347.3	79.45	76.35	246	19.94	1,514	310
52B-I	23.5	142.8	59.11	412.8	83.76	80.66	383	24.65	1,573	322
52B-II	34.5	142.8	59.11	415.3	83.91	80.42	569	24.80	1,583	324
52B-III	23.0	143.3	59.18	414.5	83.86	80.47	406	24.68	1,701	348
175	23.75	139.5	58.45	488.2	88.05	84.10	506	29.60	1,705	350
174	22.5	140.7	58.79	482.6	87.76	84.33	454	28.97	1,650	333
53B-I	21.25	146.8	59.70	487.4	88.02	84.46	264	28.32	1,736	356
176-I	20.5	138.8	58.50	591.2	93.11	89.44	556	34.61	1,847	378
176-II	21.25	140.9	58.82	588.0	92.97	89.99	596	34.15	1,847	378
176-III	20.75	138.3	58.42	585.8	92.87	89.50	560	34.45	1,847	378
Av. of all runs, 140.68		58.79								

Averages by Groups

Steam Pressure mm. Hg.	Steam Temp. ¹ Deg. C.	Steam Temp. ² Deg. C.	θ Deg. C.	K	U
189.7	65.27	64.51	5.72	543	110
189.8	65.32	65.31	6.72	736	154
214.1	68.00	68.31	9.52	823	170
274.2	73.75	73.96	15.17	1,295	265
346.8	79.41	78.69	19.90	1,556	319
414.2	83.88	83.50	24.71	1,619	331
486.0	87.94	87.75	28.96	1,697	346
588.3	92.98	93.19	34.40	1,847	378

¹ Average from data of column VI.² Average of column IV + average from data of column IX.

showing that there is some heat transmitted below the point where theoretically there is no temperature difference between boiling liquid and steam. On the other hand, heat transmission in this area cannot be as high as during boiling, for the values calculated on the basis of the whole heating surface are far too low. Evidently, then, there is some action in the lower part of the basket in heating liquid from the temperature in the down-take (which is that corresponding to the vacuum, or a little below because of radiation and incoming feed) to temperatures approaching steam temperature. Since heat transmission from steam to non-boiling water is known to be at a far lower rate than heat transmission from steam to boiling water, this furnishes a qualitative explanation for the difference in results from the two assumptions. It has not been considered worth while to try to draw any quantitative results from these considerations.

It should be noted that the corrected coefficients change very little with change in temperature drop. What slope these lines have is undoubtedly due to the factor of increased circulation pointed out by Claassen (see above). It will also be noted that these corrected curves differ from each other nearly as much with

changes in boiling point as do the apparent values for K . Many reasons for this will suggest themselves such as increased density of steam, decreased viscosity of boiling liquid, decreased viscosity (and consequently better drainage) of condensed water, better thermal conductivity of condensed water, etc. The authors at present have no definite explanation to offer as to the cause of this increase in heat transmission with increase in boiling point.

TABLE III. DATA OF INDIVIDUAL RUNS

75 Deg. Temperature Level										
I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Run No.	Time Min.	Mm. Hg.	Absolute Body Pressure, P_b Deg. C.	Corres. Body Temp., t_b Mm. Hg.	Absolute Steam Pressure Mm. Hg.	Corres. Steam Temp., t_s Deg. C.	Condensate Temp. Deg. C.	Condensate Lb.	Apparent Temp. Difference θ_1 Deg. C.	K U
46B-I	54.0	288.6	74.97	338.1	78.79	77.78	69	3.82	797	163
46B-II	54.0	287.8	74.90	340.7	78.98	78.14	85	4.08	919	188
172	61.0	286.6	74.80	386.0	82.07	80.89	256	7.27	1,374	281
173-II	60.0	290.0	75.08	387.2	82.15	81.09	222	7.67	1,333	254
38A-I	29.0	283.7	74.55	427.0	84.61	82.38	184	10.06	1,497	306
38A-II	29.75	289.8	75.06	427.6	84.67	83.11	184	9.61	1,525	412
47B-I	29.75	285.6	74.72	508.2	89.11	86.05	336	14.39	1,856	380
47B-II	30.5	290.8	75.15	510.4	89.22	86.26	330	14.07	1,820	373
48B-I	32.75	289.2	75.02	519.2	89.67	87.27	371	14.65	1,824	374
48B-II	31.05	289.6	75.06	523.8	89.90	86.74	343	14.84	1,733	355
193-I	27.0	283.9	74.60	632.0	94.93	93.96	440	20.33	1,877	384
193-II	40.0	282.9	74.51	632.8	94.96	94.09	640	20.45	1,829	374
195-I	30.0	286.6	74.82	651.6	95.74	95.79	514	20.92	1,911	392
198-I	30.0	283.4	74.55	634.2	95.02	91.65	512	20.47	1,958	401
198-II	30.0	285.4	74.72	633.6	95.0	91.43	489	20.28	1,890	387
205-I	24.5	288.6	74.96	631.0	94.86	92.04	402	19.90	1,938	397
205-II	24.0	288.8	75.0	636.0	95.10	92.0	395	20.10	1,920	393
208-III	26.5	289.6	75.07	625.7	94.66	92.63	427	19.59	1,930	395
208-IV	24.5	289.4	75.05	626.4	94.69	92.34	386	19.65	1,884	386
208-V	24.5	291.2	75.20	631.4	94.90	92.43	389	19.72	1,891	387
39A-I	33.0	285.3	74.69	618.7	94.34	91.64	524	19.65	1,898	345
39A-II	33.5	290.0	75.11	621.2	94.45	91.29	532	19.34	1,930	395
39A-III	30.0	291.6	75.24	621.0	94.44	91.15	443	19.20	1,808	370
39A-IV	33.5	292.3	75.27	623.0	94.52	91.43	512	19.25	1,864	382
208-I	23.0	292.4	75.30	765.5	100.20	98.56	552	24.90	2,245	460
208-II	24.5	292.3	75.29	761.1	100.04	98.03	558	24.75	2,145	439
207-I	31.0	286.5	74.81	762.9	100.11	98.05	754	25.30	2,242	458
207-II	25.0	288.0	74.94	761.6	100.06	97.84	590	25.12	2,189	448
207-III	25.5	284.3	74.63	767.4	100.27	97.94	607	25.64	2,166	444
209-II	30.0	277.6	74.06	767.4	100.27	97.85	734	26.21	2,175	446
209-III	23.0	281.8	74.42	776.5	100.60	98.59	573	26.18	2,218	454
41B-II	28.5	297.9	75.72	756.7	99.90	97.00	664	24.18	2,249	446
41B-III	23.9	286.7	74.78	760.2	100.01	96.80	583	25.23	2,257	465
41B-IV	26.25	287.0	74.82	769.4	100.02	97.10	661	25.19	2,335	476
60B-I	19.5	293.2	75.35	781.8	100.79	96.67	484	25.44	2,278	466
60B-II	20.2	290.0	75.09	767.8	100.28	96.28	480	25.19	2,207	452
60B-III	19.5	290.0	75.09	733.2	100.48	96.87	479	25.39	2,260	463
187	25.0	280.7	74.33	766.9	100.25	98.54	651	25.92	2,339	479
188	27.0	283.4	74.55	762.8	100.10	97.58	664	25.55	2,243	459
190-II	26.5	284.8	74.67	760.9	100.03	98.67	672	25.36	2,325	477
190-III	22.0	286.1	74.78	761.4	100.05	98.84	552	25.27	2,310	473
190-IV	28.0	285.9	74.76	762.2	100.08	99.10	724	25.32	2,375	486
197-I	29.5	286.6	74.82	763.7	100.13	96.94	708	25.31	2,213	453
197-II	30.0	287.1	74.87	759.2	99.97	96.70	731	25.10	2,268	464
201-I	24.0	293.3	75.35	916.4	105.32	102.50	729	29.97	2,340	479
201-II	24.0	292.5	75.31	916.0	105.31	102.33	734	30.02	2,364	484
192-I	16.0	283.9	74.60	906.7	105.02	104.26	502	30.42	2,384	488
192-II	23.0	284.7	74.66	906.6	105.02	104.85	720	30.36	2,379	487
192-III	22.0	283.8	74.59	905.7	104.99	104.41	676	30.40	2,338	479
49B-I	26.25	282.5	74.45	889.2	104.45	100.51	752	30.00	2,222	455
49B-II	26.25	283.5	74.54	889.6	104.46	101.22	744	29.92	2,290	469
49B-III	26.0	283.2	74.51	890.6	104.50	100.98	762	29.99	2,273	466
49B-IV	26.0	287.9	74.91	892.8	104.57	101.30	760	29.66	2,291	469
204-I	20.0	289.3	75.04	1065.8	109.76	106.80	759	34.72	2,521	516
204-II	19.0	290.4	75.14	1074.0	109.99	107.30	736	34.85	2,564	525
Av. of all runs, 287.6		74.89								

Averages by Groups

Absolute Steam Pressure mm. Hg.	Steam Temp. ¹ Deg. C.	Steam Temp. ² Deg. C.	θ Deg. C.	K	U
339.4	78.88	78.84	3.95	858	176
386.6	82.11	82.06	7.17	1,354	277
427.3	84.64	84.73	9.84	1,511	309
515.4	89.48	89.38	14.49	1,808	370
629.9	94.83	94.81	19.92	1,895	388
763.0	100.18	100.22	25.33	2,252	468
901.5	104.85	104.97	30.08	2,302	475
1,069.9	109.88	109.67	34.78	2,542	520

¹ Average from data of column VI.² Average of column IV

Another interesting fact is that at higher temperature levels both the apparent and the corrected curves are becoming parallel.

The hydrostatic head corrections furnish a ready explanation for the fact that the apparent values for K approach zero as the temperature drop approaches zero.

As the apparent temperature drop (θ_a) approaches zero, this means that t_{w_1} approaches t_s . As t_{w_1} approaches t_s , the distance below the top tube sheet where $t_b = t_s$ approaches zero. Hence the inactive part of the heating surface approaches the whole heating surface, and the total heat transmitted approaches zero. But since in calculating the apparent heat transmission coefficient the whole heating surface is used, it is evident that the coefficient must therefore also approach zero as the heat transmitted decreases.

RELATION OF STEAM TEMPERATURE TO HEAT TRANSMISSION

If a section is taken across the curves of Fig. 3 at right angles to the X-axis, one obtains a curve showing the combined effect of increased steam temperature and increased boiling point for the same temperature drop. Such sections taken for temperature drops in multiples of 5 deg. are plotted in Fig. 5. These curves are obviously developing a fairly definite limiting curve to the left, but will extend out to fill the whole space to the right. Fig. 5 furnishes an excellent explanation for the very wide variations in Kerr's results both experimental (Bull. 149, La. Agr. Exp. Sta., p. 33) and on the commercial scale. (Trans., A. I. M. E., vol. 30, p. 67.) Kerr plots K against steam temperature without any regard to temperature drop and then attempts to derive a single equation to cover all these points. Our results show how completely false it is to assume such an expression.

On the basis of his experimental results, Kerr develops an equation, $U = 225 + 17,500D$, where $D =$

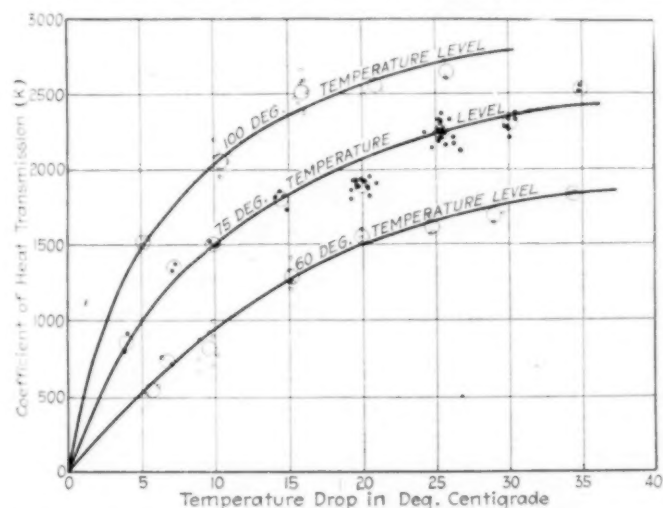


FIG. 3. RELATION BETWEEN APPARENT HEAT TRANSMISSION COEFFICIENT AND TEMPERATURE DROP FOR DIFFERENT BOILING POINTS

steam density in lb. per cu.ft. In attempting to plot this equation, it was found that the equation called for such high values of K that they came entirely off our chart. To make Kerr's figure for steam at 130 deg. check with our figure for steam at 130 deg. and the 30 deg. temperature drop, his results, as calculated and converted to metric units, are multiplied by 0.302. The resulting values are plotted in Fig. 5.

Parr (*Engineering*, vol. 121, p. 146) has suggested for multiple effect evaporators, $U = 300\sqrt{PD}$, where P is the absolute pressure of the heating steam in lb. per sq.in. and D is the density of steam in lb. per cu.ft. Parr's equation is derived from theoretical considerations and not from experimental data. Values calculated from this expression and converted to metric units are also plotted in Fig. 5. These results and those of

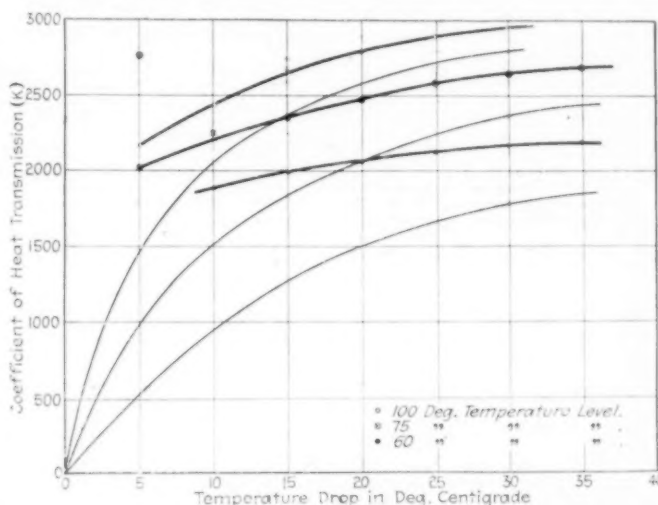


FIG. 4. DATA OF FIG. 3 CORRECTED FOR HYDROSTATIC HEAD

TABLE IV. DATA FOR INDIVIDUAL RUNS
100 Deg. Temperature Level

I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Run No.	Time	Absolute Body Pressure, t_b	Corres. Body Temperature, t_{b_1}	Absolute Steam Pressure	Corres. Steam Temperature, t_s	Condensate Temperature	Condensate	Apparent Temp. Difference, θ_a	K	U
	Min.	Mm. Hg.	Deg. C.	Mm. Hg.	Deg. C.	Deg. C.	Lb.			
63B-I	30 0	738.4	99.19	881.9	104.22	102.17	97	5.03	1,491	305
63B-II	30 0	738.4	99.19	881.7	104.21	102.41	100	5.02	1,547	317
65B-I	20 0	735.3	99.08	1,049.8	109.31	106.04	177	10.23	1,998	419
65B-II	21 75	735.3	99.08	1,049.9	109.31	106.88	204	10.23	2,110	432
65B-III	19 0	735.3	99.08	1,042.2	109.10	105.72	172	10.02	2,088	428
212-I	18 0	736.7	99.14	1,039.4	109.02	107.41	170	9.88	2,203	451
215-I	16 0	731.3	98.93	1,072.5	109.95	107.69	160	11.02	2,097	429
215-II	16 0	731.3	98.93	1,064.9	109.73	107.53	154	10.80	2,052	420
45A-I	30 0	733.3	99.00	1,048.3	109.26	105.95	260	10.26	1,955	399
45A-II	29 25	733.3	99.00	1,051.9	109.37	106.30	256	10.36	1,954	398
210-I	29 50	745.9	99.48	1,288.2	115.48	113.72	533	16.01	2,590	530
210-II	29 0	745.9	99.48	1,280.2	115.29	113.79	536	15.81	2,660	545
210-III	29 0	745.9	99.48	1,282.0	115.34	113.56	522	15.86	2,588	530
211-I	24 0	738.2	99.19	1,285.0	115.41	113.59	428	16.22	2,512	514
213-I	21 0	731.1	98.92	1,254.6	114.67	112.20	370	15.73	2,568	526
213-II	28 0	731.1	98.92	1,238.3	114.27	112.43	465	15.35	2,477	507
216-I	16 0	733.2	99.00	1,268.0	115.00	112.91	267	16.00	2,384	488
216-II	17 5	733.2	99.00	1,270.3	115.06	112.90	295	16.06	2,404	492
216-III	16 0	733.2	99.00	1,253.0	114.66	112.31	267	15.66	2,444	500
64B-II	20 0	738.4	99.19	1,458.1	119.34	115.77	445	20.15	2,520	516
214-I	26 0	729.3	98.85	1,489.6	120.17	117.74	616	21.32	2,526	518
214-II	25 0	729.3	98.85	1,481.9	119.83	117.90	532	20.98	2,634	538
191-I	18 0	744.4	99.42	1,741.7	125.02	124.04	557	25.60	2,726	558
191-II	22 0	744.9	99.44	1,743.5	125.06	124.09	656	25.62	2,621	537
191-III	25 0	745.9	99.46	1,749.3	125.16	124.39	745	25.70	2,613	535
Average of all runs, 736.7 99.13										

Averages by Groups

Absolute Steam Pressure mm. Hg.	Steam Temp. 1 Deg. C.	Steam Temp. 2 Deg. C.	θ Deg. C.	K	U
881.8	104.21	104.13	5.02	1,519	311
1,052.4	109.38	109.46	10.35	2,057	422
1,268.8	115.02	114.97	15.86	2,514	515
1,476.5	119.78	119.93	20.82	2,560	524
1,744.8	125.08	124.75	25.64	2,653	543

¹ Average from data of column VI.

² Average of column IV + average from data of column IX.

TABLE V.

Mean values at intervals of 5 deg. temperature drops, corrected for hydrostatic head: 60 deg. temperature level series.
Average body temperature at top tube sheet for whole series, 58.79 deg. C.
Average body temperature at bottom tube sheet for whole series, 69.59 deg. C.

θ_1	t_a	θ_2	θ_{mh}	Apparent K	Corrected K
5	63.79	0.0	2.30	525	1,050
10	68.79	0.0	5.00	940	1,880
15	73.79	4.20	9.60	1,270	1,984
20	78.79	9.20	14.60	1,500	2,054
25	83.79	14.20	19.60	1,660	2,117
30	88.79	19.20	24.60	1,770	2,159
35	93.79	24.20	29.60	1,850	2,188

Where $\theta_1 = 5.0$ deg., K corrected for both hydrostatic head and inactive heating surface = 2,563.

Where $\theta_1 = 10.0$ deg., K corrected for both hydrostatic head and inactive heating surface = 2,134.

TABLE VI.

Mean values at intervals of 5 deg. temperature drops, corrected for hydrostatic head: 75 deg. temperature level series.
Average body temperature at top tube sheet for whole series, 74.89 deg. C.
Average body temperature at bottom tube sheet for whole series, 81.37 deg. C.

θ_1	t_a	θ_2	θ_{mh}	Apparent K	Corrected K
5	79.89	0.0	2.30	1,005	2,010
10	84.89	3.52	6.76	1,515	2,246
15	89.89	8.52	11.76	1,840	2,346
20	94.89	13.52	16.76	2,070	2,470
25	99.89	18.52	21.76	2,240	2,573
30	104.89	23.52	26.76	2,365	2,640
35	109.89	28.52	31.76	2,435	2,684

Where $\theta_1 = 5.0$ deg., K corrected for both hydrostatic head and inactive heating surface = 2,750.

TABLE VII.

Mean values at intervals of 5 deg. temperature drop, corrected for hydrostatic head: 100 deg. temperature level series.
Average body temperature at top tube sheet for whole series, 99.13 deg. C.
Average body temperature at bottom tube sheet for whole series, 102.23 deg. C.

θ_1	t_a	θ_2	θ_{mh}	Apparent K	Corrected K
5	104.13	1.90	3.45	1,490	2,160
10	109.13	6.90	8.45	2,050	2,426
15	114.13	11.90	13.45	2,370	2,643
20	119.13	16.90	18.45	2,570	2,786
25	124.13	21.90	23.45	2,710	2,890
30	129.13	26.90	28.45	2,800	2,952

Kerr are reproduced here merely to illustrate how impossible it is to represent heat transmission over a range of values for either boiling point, steam temperature or temperature drop by any expression which does not involve at least two of these three factors.

It will be seen by a comparison of the corrected values for K and the apparent values for K that one part of the cause for low coefficients in the latter bodies of multiple effect evaporators is accounted for by the effect of hydrostatic head. Of the many factors which affect heat transmission coefficients, hydrostatic head is the one which is susceptible of calculation. The authors believe that if values reported in the literature for heat transmission coefficients had been uniformly corrected for hydrostatic head, the results would be found much more concurrent and systematic than they have been thought to be. As work progresses in the evaporator experiment station and more data are accumulated on both apparent and corrected heat transmission coefficients over a wider range of conditions, it seems not unreasonable to expect that the choice of the coefficient for the different bodies of the multiple effect may not be such a difficult matter in the end. Removing the factor of hydrostatic head may remove much of the uncertainty regarding heat transmission coefficients at low boiling temperatures or low temperature drops.

CONCLUSIONS

The following conclusions for the present must be taken as indicating tendencies only and must be applied with caution to evaporators which differ very much in design from the evaporator in which they were determined:

1. The apparent coefficient of heat transmission in

vertical tube evaporators decreases in temperature drop and approaches zero for zero temperature drop.

2. The apparent coefficient of heat transmission increases with boiling point for a given temperature drop (which also means increasing steam temperature).

3. Correcting the apparent heat transmission coefficients for hydrostatic head gives figures which change but little with temperature drop. This remaining

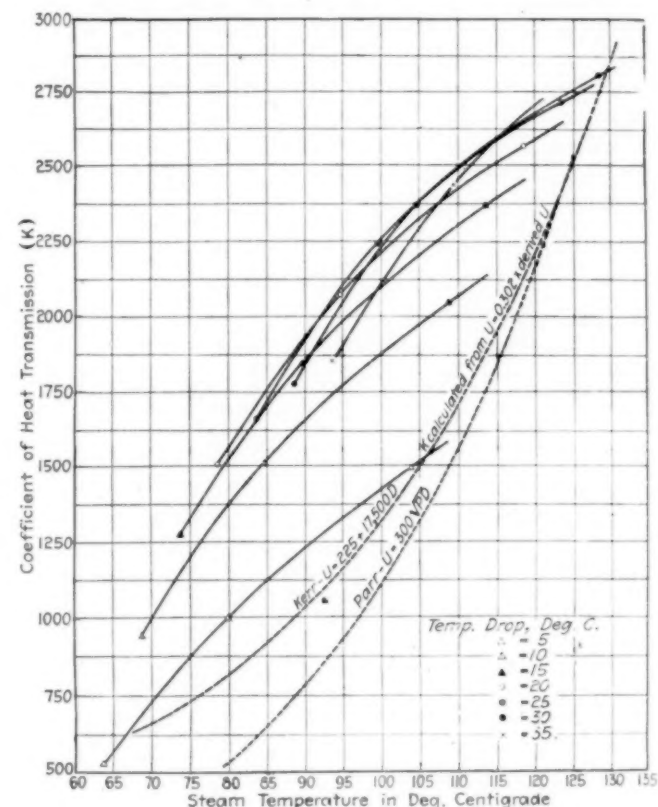


FIG. 5. VARIATIONS IN HEAT TRANSMISSION WITH STEAM TEMPERATURE, FOR VARIOUS TEMPERATURE DROPS

change is probably due to increased circulation at increased rates of boiling.

4. The corrected heat transmission coefficients used show considerable differences as the boiling point is increased and the temperature drop held constant.

5. It is impossible to represent heat transmission coefficients for different boiling points, different temperature drops and different steam temperatures by any expression which does not consider at least two of these three factors.

ACKNOWLEDGMENTS

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New Zealand Prohibits Exportation of Adulterated Kauri Gum

The New Zealand Government published in the *New Zealand Gazette* of May 27, 1920, an order in council prohibiting the exportation of kauri gum which has been in any manner adulterated or mixed with other gum.

Legal Notes

BY WELLINGTON GUSTIN

Decree Against Continental Sugar Co. Modified— Byproduct Plant Is Abandoned

In a recent decision of the Supreme Court of Michigan the Continental Sugar Co. and the United Engineering Co. were defendants. The sugar company operates a plant at Blissfield, Lenawee County, Mich., for the manufacture of beet sugar. Among its waste products was a liquid known as Steffens water, which developed an offensive odor and could not be run into the river there, and this it was compelled to store at some expense. The United Engineering Co. believed that by a process of evaporation this waste product could be converted into a valuable byproduct, and entered into an agreement with the sugar company, whereby the engineering company agreed to install a plant for such purpose at its own expense on a part of the sugar company's premises, the net profits to be divided between them. This contract was to cover a period of ten years from October, 1917. The sugar company had the option to purchase at any time after three years.

The engineering company let the job of constructing and installing the plant to J. C. Carland & Co. The plant was completed and operated for a few months, but was then closed because its operation was not profitable. Payment for its services having been made by the engineering company, Carland & Co. sought to foreclose its lien upon the plant against the two companies. The trial court gave a decree against the companies and found the amount due to be a "lien upon said refining or potash plant, equipment and appurtenances and leasehold rights."

The Supreme Court upheld this decree except it provides that should the purchaser, at a sale of the property, remove the buildings, the premises should be restored to substantially the same condition as before the construction of the plant. This modification of the decree was obtained upon the appeal of the Continental Sugar Co., one of the defendants.

How a Loosely-Drawn Contract Caused Loss to Glue Manufacturer

Interesting facts on how loosely business is sometimes conducted are brought out in the action of the Oscar Schlegel Manufacturing Co. against Peter Cooper's Glue Factory; so also is the law applying to a sales contract to furnish one with chemical requirements covering a period.

The plaintiff was a jobber exclusively, handling glues, wax, paints and chemicals. It bought only for retailing to the trade and did not manufacture or use any of these articles in its own business. The defendant glue factory wrote plaintiff, stating that it had been instructed by one of its officers to enter contract of said jobber "for your requirements of special BB glue for the year 1916, price to be 9c. per pound. . . . delivery to be made to you as per your orders during the year." This writing, together with the jobbers' written acceptance thereof, was held by the court to show that there existed a valid contract between

the parties. The parties admitted these writings constituted the only agreement between them, but defendant claimed that it lacked mutual promises and therefore was unenforceable when it sought to avoid deliveries.

DEFENDANT REFUSES DELIVERY

It appears that the parties entered upon performance of the agreement and deliveries were made from time to time amounting to 169,800 lb. Between October and December, 1916, the jobber ordered 79,891 lb. of glue, to meet its requirements, but defendant refused to deliver the same. The jobber in anticipation of the performance of this contract on the manufacturer's part had sold 42,000 lb. of this glue, and as it could no longer be bought in the open market it lost its profits on such sales. Other damages sustained by refusal to perform on part of defendant brought plaintiff jobber's damages up to \$6,431.28, for which it recovered a judgment.

The jobber filled the orders of its customers as it received them by calling upon the factory to deliver the goods under the contract. Therefore the jobber's requirements for the year 1916, in special BB glue, were the amounts of orders received therefor from its customers to whom its salesmen had sold such goods.

SYSTEM WAS THE USUAL ONE

This method of doing business, and the meaning of the term "requirements" as used in the contract, were concededly well known to the manufacturer, which had done business with the jobber under the same system as far back as 1910. The contract for 1915 was also for the jobber's "requirements" of special bookbinder's glue, for the balance of the year from March 3, 1915, at a fixed price quoted. No question arose as to the meaning of this contract, nor, said the court, did any question arise as to the meaning or validity of the contract for the year 1916, until the price for this special glue rose so high that the contract became very valuable to the jobber, and entailed a corresponding loss of profit to the manufacturer which it could have made by selling elsewhere. The contract price was 9c. per pound, and, by December, 1916, prices were quoted as high as 25c.

Under these conditions the jobber sought to reap a legitimate advantage from its contract, and by soliciting the trade received orders for the last three months of 1916 aggregating 126,100 lb. Instead of repudiating the contract, the manufacturer undertook to place an arbitrary limitation upon the same, by saying it would give the jobber 10 per cent more than it had purchased in 1915, or about 40,000 lb. But despite this the manufacturer never notified the jobber to cease taking orders from its customers for delivery of this glue, nor did it ever notify the jobber that it would not live up to its contract.

MANUFACTURER COULD HAVE PROTECTED HIMSELF

The manufacturer had not protected himself against any abnormal variation in price during the year, nor had he limited the amount to be furnished. The only proviso in the contract which he cared to insert was that the contract was contingent upon fires, strikes, accidents and other causes beyond the control of the parties. A rising market, says the court, could have been guarded against by the factory, by inserting in the contract a clause fixing the maximum amount which

the plaintiff might be entitled to receive thereunder, but instead the manufacturer made an absolute contract at a fixed price for the entire year to deliver as much glue as the jobber might be able to sell.

CONTRACT WAS MUTUAL, SAYS COURT

As for the contract not being mutual, the facts are that if the jobber had taken orders for this quality of glue, and had failed to buy the amount to fill such orders from the defendant, the latter could have held the jobber under the contract and recovered the damages which it sustained by reason of the jobber's failure to order such glue from the defendant. This it could have done, no matter how low the market price might have fallen during the year. The parties entered upon this contract with their eyes open to all the conditions then existing or which might possibly arise, said the court, and with the intention of being mutually bound thereby. The mere uncertainty as to the amount of glue which might be required to be furnished under the contract is no reason why it was not a mutual one, nor does it make the contract unenforceable.

JOBBER HAD RIGHT TO SOLICIT ORDERS

The customers' orders were received by the jobber and transmitted to defendant under the contract. The jobber's good faith in soliciting the orders, and their validity, were not successfully attacked. In the absence of any notification from the manufacturer that it would not or could not fill all its orders, the jobber had a right to proceed legitimately and in good faith to solicit orders from the trade and expect the filling of these orders by the manufacturer. The manufacturer had no right to limit arbitrarily the amount which the jobber should receive under the contract, and it was therefore liable for the damages which the jobber sustained. Thus the Appellate Division of the New York Supreme Court affirmed judgment against the Peter Cooper Glue Factory.

SAME SITUATION IN ANOTHER CASE

In another case the same situation was presented to the New York Court of Appeals. There also the parties had left the contract open and indefinite as to the quantity of the goods the purchaser might order from time to time. The seller had there sought to have the contract reformed, so as to call for only the usual amount of goods sold in the preceding year, as an answer to the buyer's suit for damages sustained by reason of the seller's refusal to furnish the goods called for under its orders for the second year. Here the court said:

"It is quite probable that this controversy originated in a circumstance which the defendant, at least, had not anticipated or provided for. After the execution of the contract there was a large advance in the market price of iron and the manufactured products of iron, and consequently the value and selling price of the goods covered by this contract advanced in the same or possibly in a greater proportion.

"The needs of the plaintiff could be indefinitely enlarged, when the market was in such a condition as to enable it to undersell its competitors in the same business, in consequence of a favorable contract with the manufacturer of the goods. If a party contracts for goods upon a rising market, he is ordinarily entitled to such profits as may accrue to him by reason of a prudent or favorable contract."

Determination of Naphthalene in Crude Naphthalene and Tar

BY JOHN C. PASTRE*

The following rapid and accurate method for determining naphthalene in crude naphthalene and tar was worked out by R. C. Downing, chief chemist, and the author, while endeavoring to determine the yield of naphthalene from our products at the new plant of the Steel & Tube Co. at Indiana Harbor, Ind.

Distil 1,000 g. of tar into two receivers, collecting in the first receiver all the distillate up to 270 deg. C., and in the second receiver the fraction obtained between 270 deg. C. and 300 deg. C. It is necessary to use an air-cooled condenser when the naphthalene begins to come over and to gently heat the condenser with a flame to prevent freezing.

The first fraction is then freed from water by means of a pipette and the fractions combined and refractioned. The water is again removed as before and the crude naphthalene allowed to solidify. This is weighed as crude naphthalene.

Ten grams of the crude naphthalene is then weighed on a balance and dissolved in 100 to 200 c.c. of naphthalene-free benzol. When solution is complete make the volume up to 250 c.c., with benzol. Pipette off 5 c.c. of this solution and place in a dry 100 c.c. flask containing 0.7 g. of picric acid and allow the picric acid to dissolve.

When solution is complete place the flask in a water bath at 60 deg. C. and pass air over the solution. Precaution must be taken to keep the liquid level in the flask above the water level. When the benzol is entirely evaporated and the odor of benzol is no longer detected, dissolve the residue in the flask in 10 c.c. of alcohol. Make the volume up to 100 c.c. and cool in an ice bath. Filter off 50 c.c. and titrate with N/10 sodium hydroxide, using methyl red as an indicator. Run a blank determination with 0.7 g. of picric acid and subtract the first titration (times 2) from the blank. This gives the difference due to the formation of naphthalene picrate, and when multiplied by 2.56 gives the grams per liter of naphthalene.

Since a theoretical solution of 40 g. per liter was made, the per cent of naphthalene in the crude naphthalene is calculated by dividing the grams per liter found by 40 and multiplying this result by 100.

It is best, however, to determine a factor on the solution used by running a sample of pure naphthalene in conjunction with the test.

The results on the crude naphthalene are then calculated back to the original weight of tar.

Hydro-electric Development in Ceylon

The Public Works Department, Ceylon, has taken up the work of investigating the island's hydro-electric resources, which work was delayed by the war, and it is expected arrangements will proceed rapidly for the early initiation of the proposed electrification of the island's industries and the partial transformation of the transportation systems for steam to electricity, including the extension and development of the use of electricity for domestic purposes in Colombo and other centers of population. Although the standard American frequency of sixty cycles has been prevalently employed in Eastern countries during recent years the adoption of the British standard of fifty cycles is now recommended.

*Laboratory Manager, Steel & Tube Co., Indiana Harbor, Ind.

Bituminous Acid-Proof Coatings for Acid-Proofing Concrete Surfaces*

A Condensed Form of the Recommendations of the Bureau of Standards as to the Coating of Concrete Floors, Vats and Tanks Exposed to Acids, Oils and Similar Substances

THREE methods of treatment have been used for the protection of concrete floors, vats and tanks against mineral acids and acid salts, the method selected depending upon the character of surface to be covered, the concentration and temperature of the acid and whether the coating was required to resist abrasion. The materials are bituminous compositions of various kinds.

BITUMINOUS PAINTS

The bituminous paints are used primarily on account of their cheapness and ease of application and give fair service on tanks or other vessels with rather smooth walls, such as is obtained with a plaster or grout coat, and when exposed to mineral acids of low concentration. Two kinds are marketed—those made with an asphalt and those with a coal-tar pitch base, thinned to the desired brushing consistency with suitable solvents. For acids of the lower concentration, the kind of base selected is immaterial. The efficiency of the coating depends upon its thickness and continuity. This can best be obtained by using a thin priming coat to insure a bond with the concrete surface, and when this is thoroughly dry, carefully applying a thicker coat of similar material. It is important that the concrete surface be fairly dry and dust-free. Special care should be taken to touch up all dull, brown, porous and uncoated spots. At least one week should elapse after the application of the last coat before filling the tank with acid.

Satisfactory material has been obtained on the following specification:

Acid-Proof Black. This material shall be composed of a high grade of bitumen thinned with suitable volatile solvents to furnish a smooth, black product which shall dry in twenty-four hours and be unaffected by mineral acids of specified concentration.

It must contain at least 40 per cent of non-volatile, shall not settle, liver or thicken in the container, and shall conform to the following requirements:

(a) When flowed on a piece of clean sheet iron approximately 4 x 6 in. and 0.016 in. thick and allowed to dry for one week at room temperature, the film must withstand bending double quickly over a rod 5 mm. in diameter without cracking or flaking.

(b) A test piece prepared as above and dried for one week at room temperature shall be laid flat and in different places several drops each of sulphuric acid, specific gravity 1.3, nitric acid, specific gravity 1.23, and hydrochloric acid, specific gravity, 1.09, shall be allowed to remain on the surface of the film for six hours. On examination the film shall show only slight dulling and the metal beneath shall show no corrosion.

BITUMINOUS ENAMELS

The bituminous enamels are used where protection for an indefinite period against relatively strong acids is desired and when the cost of the structure justifies the extra expense of application. They can be employed

both on smooth and rough walls and surfaces, and on account of its thickness, continuity of the coating is more easily obtained. They will not resist abrasion at elevated temperatures.

The bituminous enamel consists of two materials—the priming solution and the enamel proper. The priming solution consists usually of a relatively high-melting-point bitumen, of low susceptibility to temperature changes, dissolved in sufficient volatile solvent to give a paint of thin brushing consistency. The enamel proper consists of a bitumen similar to that used in the primer with or without a finely powdered siliceous mineral filler. Some mineral filler is desirable, as it increases the resistance of the enamel to flowing and sagging at elevated temperatures and to abrasion. The enamel is applied hot over the properly dried priming coat.

The following specification should obtain material suitable for tanks exposed to relatively high and wide variation in temperature:

This material shall consist of a bituminous primer and a bituminous enamel which when applied to concrete surfaces will give a coating which will possess good adhesive qualities, will not flow or sag from a vertical surface at the highest prevailing temperature, will not become brittle at 32 deg. F., and will resist mineral acids of specified concentrations for long periods.

Bituminous Enamel. The enamel shall consist of a homogeneous mixture of a bitumen of relatively high melting point and finely powdered siliceous mineral filler. The total amount of mineral filler, as determined from the ash, shall not exceed 40 per cent nor be less than 15 per cent by weight. Within the above limits the satisfactory working qualities of the enamel shall control the quantity of mineral filler to be used. The mineral filler must be resistant to hydrochloric, sulphuric and nitric acids, and must pass a sieve the openings of which are not greater than 0.14 mm. (0.0055 in.). (This corresponds to about 100-mesh sieve.)

Bituminous Primer. The primer shall consist of a like bituminous material, containing no added mineral matter, thinned with a solvent to a satisfactory brushing consistency. It shall dry to a tacky state in thirty minutes and shall not flash below 30 deg. C. by the Abel closed tester. The solvent used shall have a minimum toxic effect upon workmen applying the primer within an enclosed space.

These materials shall conform to the following requirements:

(a) **Workability.** The enamel and primer shall be applied to dry, clean, dust-free concrete slabs in the following manner: The slabs shall be coated with the primer and when this has dried to the tacky state, the enamel shall be mopped on until a coating 3 to 5 mm. ($\frac{1}{8}$ to $\frac{1}{4}$ in.) thick is obtained. The temperature of application shall not exceed 350 deg. F., at which the enamel shall brush and spread out to a fairly smooth coating.

(b) **Brittleness Test.** The brittleness is best determined by testing the material applied to a steel plate. A steel plate 30 cm. x 30 cm. x 1.6 mm. (12 x 12 x $\frac{1}{16}$ in.) shall be primed and coated to a thickness of 3 to

*A report prepared by the Bituminous Materials and Cement Sections of the Bureau of Standards.

5 mm. ($\frac{1}{4}$ to $\frac{3}{8}$ in.) with the enamel, and after cooling for twenty-four hours shall be subjected to the following test: A 750-g. (1.65-lb.) steel ball shall be dropped from a height of 244 cm. (8 ft.) on the coating at a point at least 10 cm. (4 in.) from the edge of the plate. The plate is to be supported in this test by a block or the floor in such a manner that there shall be support beneath the point of impact. In this test none of the coating shall have shattered from the plate nor shall radial cracks develop longer than 4 cm. (1.6 in.) from the center of the point of impact. The coated steel plate shall then be laid coating downward, on a board through which a hole about 8.9 cm. (3.5 in.) in diameter has been cut. The same steel ball shall be dropped from a height of 244 cm. (8 ft.) and shall strike the steel plate over the center of the hole in the board supporting the plate. The coating must not shatter from the plate by this test nor shall cracks develop in the coating further from the center of the point of impact than the boundaries of the hole in the board.

(c) *Acid Test.* The test piece made in the workability test may be used for this test. The coating shall be unaffected except for a slight dulling when exposed in different places to the action of sulphuric acid, specific gravity 1.3 (about 40 per cent), nitric acid, specific gravity 1.22 (about 35 per cent), and hydrochloric acid, specific gravity 1.09 (about 18 per cent), for twenty-four hours.

Covering Power. The materials shall have the following covering power:

Bituminous primer, 1 gal. to cover not less than 100 sq.ft.

Bituminous enamel, 1 lb. to cover not less than 2 sq.ft., $\frac{1}{8}$ to $\frac{1}{4}$ in. thick.

Application. Extreme care should be taken in the application of these materials so as to obtain a continuous coat free from blisters and pinholes, and bonding well to the concrete surface. The concrete surface should be as dry as possible, and free from oil and grease and all loose particles and dust. The latter can be removed by brushing the surface first with a wire brush and then removing the very fine dust with a soft bristle brush. The primer then should be applied and should be worked thoroughly into all hollows and pores. The bond between the concrete surface and the enamel coat depends to a great extent upon the proper application of the primer. Before the application of the enamel, the primed surface should be thoroughly inspected and all brown, dull or uncoated spots should be touched up. When the primer has dried to a slightly tacky state, it is ready for the enamel.

The enamel should be melted and carefully heated until it is sufficiently fluid for brushing, avoiding decomposition and carbonization. The temperature of the material in the kettle should not exceed 375 deg. F. When fluid it should be mopped on quickly, as it sets and hardens very rapidly.

For tanks below ground or those in which the temperature never exceeds 100 deg. F., material with a lower melting point made from a softer bitumen may be used on account of its greater ease of application.

For tanks in which the temperature range does not exceed 30 deg. F., a slightly more brittle material might be used which although shattering under the impact of a 750-g. (1.65-lb.) ball from a height of 244 cm. (8 ft.) withstands its impact from a height of 183 cm. (6 ft.)

BITUMINOUS MASTICS

The bituminous mastics are used almost exclusively for floors on account of the thickness of the layer which must be applied, but they can be used for tanks or vats if proper care is taken in the application. They are easily applied, bond well to concrete surfaces and resist moderate abrasion and fairly strong mineral acids. They are of two kinds, depending upon whether they are applied hot or cold.

Where a thin surfacing for concrete floors is desired, cold mastic is ordinarily used. This consists of two compositions—the priming solution and the body coat or mastic. The primer consists of a hard asphalt dissolved in a volatile solvent to a fairly thin brushing consistency. The mastic consists of the primer into

which sufficient abestos and finely powdered siliceous mineral fillers are ground so as to obtain a very thick pasty fibrous mass. Occasionally, a finishing coat is applied where a color other than black is desired. In that case pigments are added to the last coat of the mastic. The method of application is as follows: The smooth concrete surface is thoroughly dried and cleaned of all grease and dust. The priming coat is then applied, and when it has dried to the tacky state a thin layer (about $\frac{1}{8}$ in.) of the mastic is trowelled on. When this has dried, successive $\frac{3}{8}$ -in. coats of the mastic are applied until the required thickness is obtained.

The hot mastics are somewhat similar to the mixtures used in laying sheet asphalt pavements. However, they contain a little more asphaltic binder, so that when they are heated to the temperature where the asphalt is fluid they can be poured and trowelled into place. They are satisfactory only when applied in layers 1 in. or more in thickness. When mixed and ready for laying they consist of about 15 per cent of asphaltic binder, about 20 per cent of finely powdered siliceous mineral filler, and the remainder properly graded sand or other aggregate, containing no particles larger than those passing $\frac{1}{4}$ -in. sieve. The proper grading of the aggregate so as to get a composition having a maximum density is very important, as upon it the stability and efficiency of the finished floor largely depends. The thoroughness with which the materials are mixed and the care with which they are laid also contribute to the life of the finished surface.

Hot mastics have given very satisfactory service in a wide variety of chemical and dye manufacturing plants, plating, acid tank and storage battery rooms, the pulp rooms of paper mills, and in the leaching tanks of copper and gold refineries.

For convenience in shipping and handling on the job, the asphalt cement and the powdered mineral filler are usually mixed by the manufacturer and cast into blocks weighing from 50 to 75 lb. each, which are marketed as "rock asphalt mastic." For use these blocks are broken up, melted and fluxed with additional asphalt and mixed with the sand or other aggregate. However, the practice of mixing all of the raw materials on the job in suitable mastic machines is becoming more common, as it is more economical, gives a more homogeneous mixture, and danger of overheating and charring of the asphalt is minimized.

Satisfactory materials have been obtained on the following specification:

Bituminous Acid Proof Mastic. The bituminous mastic shall be composed of asphalt cement, clean, sharp grained sand, and fine absorbent siliceous dust. These materials shall be mixed in the proper proportions and shall be applied hot to the concrete surface, which shall be dry and free from dust and shall have been previously coated with a priming or bonding solution which has just reached the tacky state.

Asphalt Cement. The asphalt cement must be of refined asphalt, and shall be homogeneous and free from water.

It shall meet the following requirements:

Melting point (ring and ball), 150 to 180 deg. F.

Penetration at 25 deg. C., 100 g., 5 sec., 15 to 40.

Total bitumen soluble in carbon bisulphide, not less than 90 per cent.

Sand. The sand shall be clean, hard grained and moderately sharp, and shall be free from clay, silt and organic matter.

It shall be well graded from coarse to fine, and when tested by means of the laboratory sieves shall meet the following requirements:

	Per Cent
Passing 4-mesh sieve	100
Total passing 20-mesh sieve	50 to 80
Total passing 50-mesh sieve	not more than 30
Passing 100-mesh sieve	not more than 5

Mineral Filler. The mineral filler shall be any finely powdered acid-resistant siliceous material, 85 per cent of which shall pass a 100-mesh screen.

Priming Solution. The priming solution shall consist of an asphaltic base similar to the asphalt cement and shall be thinned to a good brushing consistency with a suitable volatile solvent.

Mixing. The sand or the mixture of the sand and mineral filler and the asphalt cement shall be heated separately to about 300 deg. F. When the asphalt cement is completely fluid, the hot dry aggregate is stirred in and thoroughly mixed until the mass is homogeneous and sufficiently fluid for pouring. The temperature of pouring should be between 350 and 400 deg. F. The aggregate if dry may be stirred in without previous heating, but in that case a longer period of heating and stirring will be required.

Laying. The concrete surface shall be primed and allowed to dry to the tacky state. The hot mixture, prepared as above, shall then be poured, spread on, smoothed out and worked into place with suitable tools. After the surface has begun to set, it shall be sprinkled with hard-grained sand and a little mineral dust and rubbed down until it is smooth. The finished layer should be at least 1 in. thick.

Approximate Formula. The composition varies within narrow limits according to the service required of the material, and when ready for laying should be as follows:

	Per Cent
Asphalt cement	12 to 15
Mineral filler	20 to 25
Sand or other aggregate	60 to 70

Names of manufacturers who can probably furnish materials conforming to the foregoing specifications are given in the following list:

Bituminous Paints:

Barber Asphalt Paving Co., Philadelphia, Pa.
Standard Paint Co., Woolworth Bldg., New York City.
The Barrett Co., 17 Battery Pl., New York City.
The Biturine Co., 24 California St., San Francisco, Cal.
The Paraffine Paint Co., San Francisco, Cal.
Certainteed Products Corp., St. Louis, Mo.

Bituminous Enamels:

American Bitumastic Enamels Co., 17 Battery Pl., New York City.
Barber Asphalt Paving Co., Philadelphia, Pa.
Johns-Manville Co., New York City.
Briggs Bituminous Composition Co., 17 Battery Pl., New York City.
Standard Paint Co., Woolworth Bldg., New York City.
The Biturine Co., 24 California St., San Francisco, Cal.

Bituminous Mastic (Cold):

Thomas Moulding Brick Co., Chicago, Ill.
Insulite Mastic Flooring Co., Aurora, Ill.

Bituminous Mastic (Hot):

Barber Asphalt Paving Co., Philadelphia, Pa.
Warren Chemical & Mfg. Co., 17 Battery Pl., New York.
Johns-Manville Co., New York City.
Standard Paint Co., Woolworth Bldg., New York.
The Biturine Co., 24 California St., San Francisco, Cal.
Paraffine Paint Co., San Francisco, Cal.

Newly Discovered Australian Pigment Deposits

The discovery of an extensive deposit of ocher and sienna at no great distance from the surface and within thirty miles of Adelaide, South Australia, has attracted much local interest, particularly in view of the abnormally high price of imported paint pigments.

Though regarded primarily as a mining proposition the discovery is important in a manufacturing sense. During the years of war several new paint works were established in Australia, but the promoters were handicapped to some extent by the necessity of importing most of the requisite raw materials. This new find of ocher and sienna, therefore, extends the possibilities of the paint industry and should render it largely independent of overseas supplies of the basic pigments.

Oil Shales and Their Economic Importance*

BY MARTIN J. GAVIN†

THE twentieth century has often been spoken of as the age of petroleum, and from many viewpoints it can justly be considered so. Certainly the petroleum industry is one of enormous importance to this country, industrially, financially and economically. The United States, however, at present producing over 60 per cent of the world's total output of petroleum, is not producing petroleum at a sufficient rate to provide for its own domestic consumption. For several years this country has been importing increasing quantities of crude and partly refined oils from Mexico, and has been drawing heavily on domestic stocks of petroleum. Production in the United States is increasing, but it is not increasing at the same average rate as domestic consumption, nor is it probable that in the future domestic production will increase sufficiently to satisfy the demands of domestic consumption, but on the contrary, in the opinion of those best qualified to know, the peak in the curve of domestic production of crude petroleum will be reached in a comparatively few years, whereas the consumption of petroleum and its products will increase at a continually growing rate. This country, then, must turn, and, as the increasing imports from Mexico indicate, is turning, to other sources than the crude petroleum produced in this country to make up the deficit between domestic production and domestic consumption of petroleum and its products.

INDUSTRIAL PRODUCTS DERIVED FROM PETROLEUM

The chief products of petroleum are motor fuels, kerosene, fuel oils and lubricating oils. Of these, the increasing demand for motor fuels or gasoline is perhaps the greatest, and that of fuel oils probably next greatest. The ever-growing use of the internal combustion motor, especially in automobiles and trucks, accounts for the first, and the increasing use of fuel oil, chiefly for steam-raising purposes, accounts largely for the second. Lubricating oils are, of course, of prime importance, as machinery must be lubricated if it is to operate.

GROWING NEED FOR PETROLEUM PRODUCTS SUBSTITUTES

To help make up the deficit in our supply of petroleum we can expect to draw on the enormous potential petroleum supplies of Mexico at an increasing rate, and by the use of new and improved processes of manufacture a greater percentage of the petroleum products for which there is the greatest demand will undoubtedly be obtained from petroleum. The more efficient utilization of these products, as for example through the development and use of the Diesel engine and the gradual change in the design of our present internal-combustion motors, enabling them to use lower-grade fuels, will perhaps tend to relieve the growing shortage. Hydro-electric power, or electricity otherwise produced, can be expected to take the place, to a certain extent at least, of fuel-oil installations on land. However, all these expedients have their practical limitations, and it is to be expected therefore that in the comparatively near future new sources of products similar to those now

*U. S. Bureau of Mines, reports of investigations. A paper presented by permission of the Director, U. S. Bureau of Mines, before the thirteenth convention of the Utah Academy of Science, April 3, 1920.

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being derived from oil-well petroleum will have to be developed. As a matter of fact, some are already being developed.

SOURCE OF PETROLEUM PRODUCTS SUBSTITUTES

There are possibilities of importance in the development of the production and use of benzol as a motor fuel and other coal-tar products as Diesel engine fuels and as substitutes for other petroleum products. There are also important possibilities in the commercial production of alcohol as a motor fuel. In fact, blends of alcohol, benzol and petroleum distillates are being marketed in the East at the present time as motor fuels and are giving satisfaction in use.

Taking all these considerations into account, however, it is the opinion of many that the oil shales of Utah, Colorado, Wyoming, Nevada and possibly other states are extremely important as new sources of products similar to those now obtained from oil-well petroleum. These states contain enormous deposits of oil shales which by proper treatment yield gas, oil and also, if desired, ammonia, of value as a fertilizer. The oil in many respects is similar to oil-well petroleum and yields products similar to those of petroleum.

Oil shales have been worked in Scotland and France for upward of sixty years. In the former country the industry has been successful from a financial standpoint, especially of late years, although it is passing through a difficult period at present. The industry in France has not been nearly so successful as that in Scotland. The success of the Scotch shale industry has been brought about partly by the development of cheap processes for treating the shales and the oils produced from them, but mostly by local conditions, such as competition only with high-priced petroleum products, low labor costs and the fact that the industry grew up in a densely populated region where a ready market for oil and ammonium products was available.

PRODUCTS OBTAINED FROM OIL-SHALE DISTILLATION

Oil shale contains little or no oil as such, but it contains substances which when the shale is subjected to destructive distillation yield gas, crude oil and nitrogen-containing compounds, notably ammonia, as well as other products in small and probably of unimportant value for the most part. Oil shale as a rule must be mined much as coal is mined, crushed, and heated to a relatively high temperature in closed retorts which may operate continuously or intermittently. These steps are necessary to produce the gas, crude oil and ammonia, the latter in solution in the water obtained along with the oil.

The ammonia water is then distilled and the released ammonia passed into sulphuric acid, producing ammonium sulphate. The crude oil must be refined, much as petroleum is refined, to produce the various commercial products. The refining of shale oil is more complex and in all probability more costly than the equivalent refining of petroleum. Undoubtedly, however, the shale oils can be refined and made to yield many products similar to those produced when petroleum is refined. The oils produced from the oil shales of this country will yield gasoline, burning oils and paraffine wax, all of which when properly treated will be satisfactory commercial products. Whether the more viscous grades of lubricating oils, such as lubricants for internal-combustion motors, can be produced from shale oils is doubtful, but it may be possible. Little is

known in this country as to the refining of shale oils, and this statement can be applied generally to the possibilities and technique of oil-shale operations in the United States.

ECONOMIC REQUIREMENTS FOR THE DEVELOPMENT OF AN OIL-SHALE INDUSTRY

The development of an oil-shale industry to one of considerable importance in this country will require the expenditure of many millions of dollars and take a period of many years. Such development will require much research and technical study, and will require the services of trained executives and experienced technicians. Nevertheless, when economic conditions become favorable, it is reasonable to believe that our oil shales will be of great value as a source of oils similar to those now derived from petroleum. An idea of what large-scale development of the oil-shale industry involves may be gained from the consideration that to produce one barrel of crude oil from shale, on the average at least one ton of a tough rock must be mined, crushed, heated to a relatively high temperature, and finally the residue, amounting to about 75 per cent of the original weight of the raw shale, must be disposed of as valueless. The United States now produces over one million barrels of crude petroleum per day.

Our immense oil-shale deposits practically assure us that, come what may, this country will still have its own sources of petroleum products. We should never have to be wholly dependent on foreign countries in this respect. From another standpoint the shales are also of great economic importance. The oil shales, especially of the Rocky Mountain country, occur in sparsely settled regions. Their development on a large scale means the bringing into these regions of a great number of miners and other laborers, often with their families, who will earn their living in the shale fields and spend their money in the same locality. Millions of dollars must be spent in erecting plants, developing mines and the like, much of which will be spent in the states where the oil shales occur. The shale-oil refineries will require sulphuric acid and other chemicals and supplies, which logically will be produced as near to the shale fields as possible, thus bringing in more capital and labor. Transportation facilities will be extended to meet the requirements of the shale operators, thus benefiting the regions now inadequately supplied in this regard. Prices of petroleum products in the regions contiguous to the shale operations can be expected to be relatively lower than they would be if similar petroleum products had to be shipped in.

CONCLUSION

It should again be emphasized, however, that development of an oil-shale industry to a scale sufficient to be of so much economic importance will require much study, time and money. The oil-shale industry is no business for the man of little experience and small capital. It may be compared with the development of the low-grade copper ores of the West, in that it is a large, low-grade, chemical manufacturing enterprise, requiring capital, time and trained men. The investor in oil-shale operations should know that he will probably have to wait for a long time for a return on his investment and that returns in all probability will be conservative. In spite of this, the day of the oil-shale industry is coming. When, it is difficult to predict, but some day it will undoubtedly be one of great importance.

Mid-Continent Gasoline*

BY C. K. FRANCIS†

THE gasoline of the Mid-Continent district, which includes the states of Kansas, Oklahoma, Texas and Louisiana, is a product derived from petroleum and natural gas, having a Baumé gravity between 55 and 72; initial boiling point, 90 to 140 deg. F.; a dry point between 370 and 460 deg. F., and is suitable for use in an automobile engine.

There are three methods for producing this gasoline: (1) Direct distillation of petroleum. (2) Cracking, under pressure, certain petroleum products, such as gas oil. (3) Extraction from natural gas by means of compression, absorption and refrigeration. Contrary to the somewhat general opinion, gasoline identical with some refinery gasoline may be obtained from natural gas by the absorption process.

The ordinary refinery equipment will not permit the recovery from petroleum of that very volatile product identical with compression natural gas gasoline. However, by means of suitable towers, condensing and other apparatus, it is possible to condense the petroleum vapors so as to obtain products identical with those obtained from natural gas.

During 1919 the Mid-Continent field produced over 217,000,000 bbl. of petroleum, from which there was extracted over 50,000,000 bbl. of gasoline, and while exact figures are not available, it would probably be safe to venture the opinion that 12,000,000 bbl. more of gasoline was made by special processes in pressure stills. The quantity of gasoline extracted from natural gas in this district was about 37,000,000 bbl. Then approximately 100,000,000 bbl. of gasoline was obtained last year from petroleum and natural gas out of the Mid-Continent district and placed on the market.

It is the object of this paper to outline and briefly describe some of the tests used for determining the prominent characteristics of gasoline.

The greater proportion of the gasoline marketed is obtained by the distillation of petroleum and consists of the first fraction, or cut, condensed. This product is for convenience called crude benzine.

TREATMENT OF CRUDE BENZINE

The crude benzine is transferred from the receiving tank, commonly known as a run-down tank, to a specially constructed vessel called an agitator. Most agitators in the Mid-Continent field have a capacity of from 1,000 to 2,000 bbl. When these are used singly or in pairs they are known as batch agitators because the charge of the product to be treated is a known quantity. Sometimes agitators are erected and connected in series; usually the system consists of from six to ten tanks through which the liquid passes while being treated, each unit or agitator containing the proper chemical or liquid for treating the crude benzine. Such units are known as continuous agitators. It is now the common practice to mix or agitate the crude benzine and the purifying agents by means of compressed air.

While the charge is being agitated, strong sulphuric acid is added. The quantity of acid used may vary from 1 to 15 lb. per bbl. of product treated according to its condition and the specific results desired. The

next step is to wash the benzine free from acid by showering water through it. Then, in order to be very certain that no acid remains and to remove sulphur compounds, it is washed with dilute caustic soda which is saturated with litharge. Free sulphur is added to aid in the precipitation of the lead sulphur substances. The charge is finally washed with water.

DISTILLING TREATED BENZINE

The treated benzine is pumped to a steam still and redistilled. The vapors from this may be led through special towers which serve to divide them while slightly cooling and the resulting streams may be further separated in the receiving house. In this manner a series of streams are divided from one tank to another and a number of finished gasolines produced.

Cushing, Inola and Bixby crudes (Fig. 1), which are representative of the best crudes of Oklahoma, begin to decompose or crack when approximately 60 per cent of the total volume has been distilled.

Up to this point the products extracted from the crude oil are separated by direct distillation on a basis of their boiling points. Between 550 and 700 deg., chemical decomposition takes place, with the result that the boiling point is materially lowered owing to the

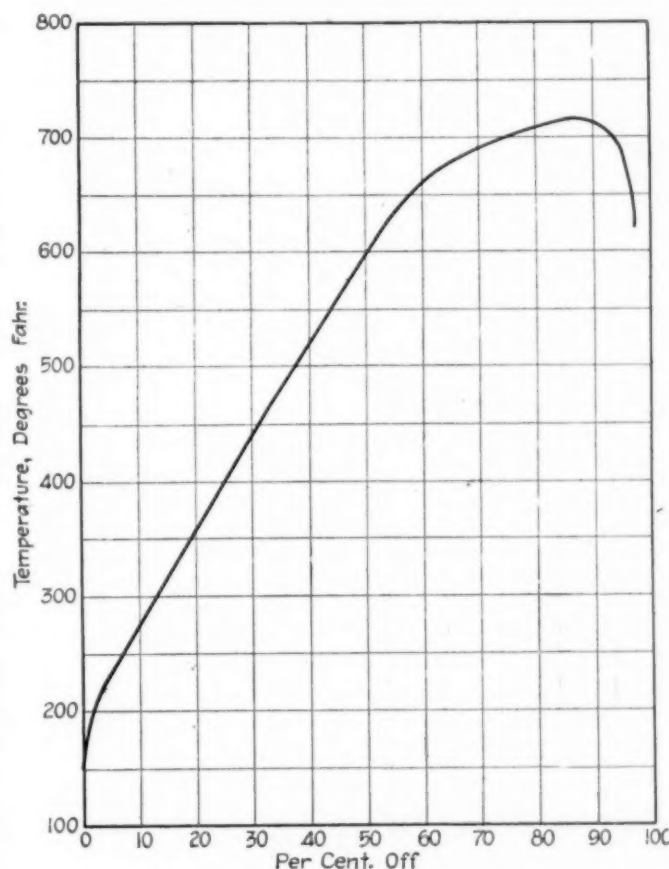


FIG. 1. DISTILLATION CURVE OF BIXBY CRUDE OF 34.6 DEG. GRAVITY

formation of cracked products from the wax or lubricating oil portion of the crude. This illustrates the difficulty of using crude petroleum in the ordinary motor. The decomposition of the oil and resulting deposition of carbon and heavy substances, including coke, brings out clearly the fact that refining is necessary for the production of an ideal motor fuel.

Probably the most apparent property of gasoline to the owner of his first car is that of color, and he with

*Paper read at the May 29, 1920, meeting of the American Chemical Society and Society of Mechanical Engineers, Tulsa, Okla.

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his fellows soon learn to demand, without knowing why, a product which must be as clear as a crystal. Gasoline, being the lightest of the common liquids obtained from the distillation of petroleum or from natural gas, should be free from the heavy oils and asphaltic substances which would produce a yellow to brown color. A very light yellowish tinge may be caused by a dirty tank, contamination with coloring matters contained in packing of the seams of the tank, faulty refining and occasionally as a result of the addition of an inferior or heavy petroleum product. The common cause of the yellowish tint found in many gasolines is faulty refining. A very large part of the gasoline on the market is the product of cracking processes. The cracking process causes the formation of unsaturated compounds and these in turn are the cause of many gasolines going off color. The unsaturated compounds are removed to a great extent by washing the unfinished gasolines with sulphuric acid.

GASOLINE DISTILLATION TEST

All gasolines used for motor fuel are subjected to the distillation test, which includes:

(a) The determination of the temperature at which the gasoline boils, or more accurately when the first

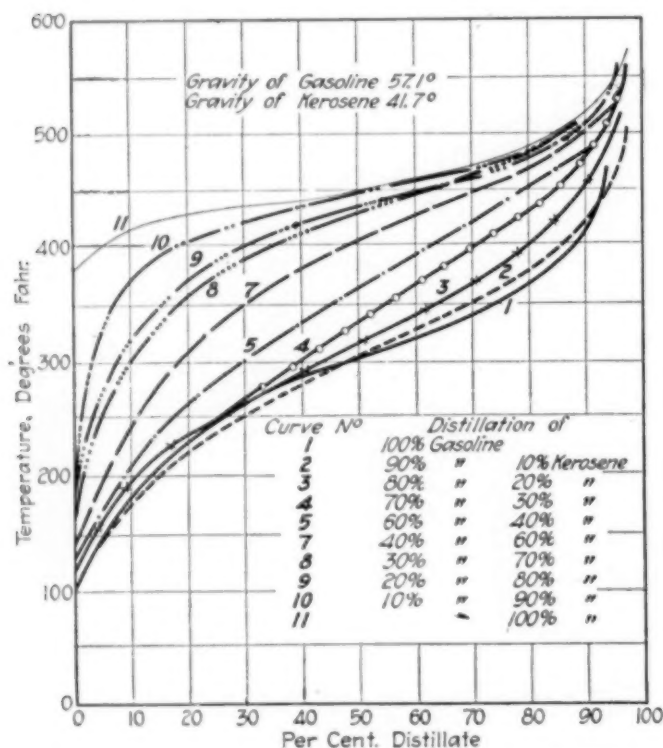


FIG. 2. EFFECT OF BLENDING OF GASOLINE WITH KEROSENE ON THE DRY POINT DISTILLATION

drop falls from the end of the condenser tube; this is known as the initial boiling point.

(b) The rate of distillation, which is determined by observing the temperature for each 10 per cent of the distillation.

(c) The dry point, or the temperature when there is no liquid remaining in the bottom of the flask, commonly known as the end point.

(d) The maximum temperature, or the highest temperature recorded at the end of the distillation.

It is unfortunate that the terms end point and maximum temperature are often confused. The dry point is

probably more often considered to be the end point than the maximum temperature, because the dry point is the temperature registered at the end of the distillation or, specifically, when no liquid remains in the flask and the observation is usually aided by the fact that there is a slight puff of smoke formed when the last particle of liquid is vaporized. The maximum temperature, on the other hand, is the highest temperature recorded during the operation of heating and may be the dry point. The maximum temperature is a point not so easily checked as the dry point and the higher temperature may be due to superheating and not actually be a physical characteristic of the gasoline.

A convenient method for illustrating the results of distillation tests is by means of a temperature per cent curve, the ideal gasoline being one that produces a

PHYSICAL AND CHEMICAL PROPERTIES OF MID-CENTINENT GASOLINE

Properties	Standard Motor and Navy Gasoline	Pressure Gasoline
Gravity, B \acute{e} .	58.0—61.0	54—60
Gravity, specific	0.7447—0.7330	0.7609—0.7368
Initial boiling point, deg. F.	95—140	100—140
Dry (end point), deg. F.	437	436—460
Flash	Below zero	Below zero
Color	Plus 25 (Saybolt)	Yellow
Odor	W. W. (Lovibond)	"Cracked"
Doctor	Sweet	Sour
Sulphur, per cent	0.01—0.05	0.02—0.08
Copper	Good	Good
Refractive index	1.4153—1.4235 at 20 deg. C.	1.4430—1.4442 at 20 deg. C.
Evaporation, minutes	2 to 8	2
Iodine number	2.0—4.0	40.0—55.0
Olefines, per cent	3.0—10.0	6.0—15.0
Aromatics, per cent	2.0—4.0	5.0—12.0
Naphthenes, per cent	2.0—15.0	5.0—10.0
B.T.U.	20,000—21,000	20,000
Vapor pressure at 100 deg. F., lb.	3	4

distillation curve which may be represented by a straight line inclined upward at an angle of about 30 deg., having a downward turn at the left end and an upward turn at the right end. The beginning of the curve shows the starting quality; the long straight line, the even distribution of the energy; and the upward turn at the end indicates the proportion and character of the heavier liquids present.

The illustration (Fig. 2) includes a number of curves representing blends made with a fair grade of gasoline and good kerosene. These curves show very clearly the influence of both products. The gasoline when present to the extent of only 10 per cent lowers the boiling point to below 200 deg. F., while the kerosene, a heavy liquid, may be easily detected in every mixture and its behavior is well indicated from the starting of the curve through to the end point. While the initial boiling point of a heavy product may be lowered appreciably by the addition of a small quantity of light liquid, it is not possible to decrease the end point or lower the boiling points of the last fractions of a blend. The heavier particles persist and may be detected in a blended gasoline when present in very small quantities.

A comparatively low initial boiling point is a desirable property for a gasoline, because it insures easy starting of the motor. But should there be no rise in the curve the liquid would be too light for motor cars and the quantity required would be large, due to the exceedingly rapid rate of vaporization. A good body or staying quality is derived from the heavier constituents of the gasoline, and is indicated on a distillation curve by the uniform rise after the first 20 per cent fraction has distilled. An exceedingly rapid rise to the curve

would indicate the presence of a large quantity of heavy oils which might cause the deposition of carbon in the cylinders. Just what a safe rise would be and the proper end point have not been determined. The temperature of the explosion chamber is probably over 2,000 deg. F., and if the correct quantity of air were admitted, there can be no question that all ordinary gasolines would be altered to gaseous forms when exposed to so much heat.

SULPHUR IN GASOLINE

The petroleum of the Mid-Continent district seldom contains more than 0.3 per cent sulphur and if the gasoline is properly refined it should contain less than 0.01 per cent total sulphur, but gasoline may be accepted on contract up to 0.04 per cent total sulphur. As indicated above, free sulphur is added to the unrefined gasoline during the refining process and if extreme care is not exercised the sulphur may be added in excess with the result that the completely refined gasoline will contain more sulphur than the untreated or unrefined product. Indeed the examination of a large number of gasolines indicates that many refiners are accidentally adding sulphur to their gasoline in this way. The harmful effect of the sulphur is evidenced in the corrosion of the copper tubing, the brass connections and the cylinders of the motors. The sulphur in the gasoline is particularly injurious to the brass and copper connections, with the result that the feed system often becomes clogged by the black scales collecting upon the openings to the vacuum feed. The sulphur is also deposited in the cylinders, and this, together with other black substances, is commonly called carbon. Analysis of this black deposit shows less than 65 per cent carbon, the remaining 35 per cent being made up of oil, asphalt, iron, silica and sulphur. Under the temperature existing in the cylinders, there can be no doubt that the sulphur combines with the iron and eventually causes serious damage.

DETERMINATION OF SULPHUR IN GASOLINE

A convenient and simple method for detecting the sulphur in gasoline has been proposed. A small piece of polished copper, or a clean penny, is placed in a beaker, covered with gasoline and heated over a steam bath for fifteen minutes. At the end of that time the copper is removed and examined. The surface will be found to have become tarnished or blackened according to the quantity of free sulphur. Analysis indicates that the deleterious action of the free sulphur becomes apparent when it is present to the extent of 0.008 per cent and very bad and corrosive in action when it is present to the extent of 0.018 per cent. The accompanying table gives the physical and chemical properties of Mid-Continent straight run gasoline obtained by direct distillation from the crude petroleum and a sample of unrefined pressure gasoline made by distilling gas oil under pressure.

In a very short period gasoline has advanced from an annoying substance to a product of great commercial importance. When first used as a motor fuel very simple requirements for quality were mentioned; usually gravity, covering a broad range, and color were sufficient.

The gasoline on the market today is classified under very carefully drawn specifications as illustrated in the accompanying table.

The Potash Deposits of Alsace

One of the outstanding questions of the great war was "Will Alsace be restored to France?" This question, full of national interest and appeal as it was to France and Germany, was of still wider commercial interest, for the only known deposits of potash of proved commercial value in the world except the deposits near Stassfurt, Germany, are in Alsace. The search for deposits in the United States, however, is being continued, and in that search a study of the origin, extent, and value of the deposits in Alsace is likely to be very useful. For this reason Hoyt S. Gale, of the United States Geological Survey, and Frank K. Cameron, of the Bureau of Mines, were sent to Alsace early in 1919, soon after the armistice had been signed, to examine and report upon the deposits there.

LOCATION OF THE DEPOSITS

The potash deposits of Alsace lie beneath an open stretch of the valley of the Rhine in southern Upper Alsace, about 25 miles north of the Swiss border.

No evidence of either the potash or of the large masses of common salt that are associated with it is found at the surface; the potash was discovered only by borings put down in search of coal. Under the German rule a large part of the potash field was owned and operated by the great potash monopoly, the German Kali Syndikat. All the potash properties in this region are now in the hands of representatives of the French Government.

THEIR DEPTH AND CHARACTER

The potash deposits lie at depths ranging from 1,200 to 2,200 ft. below the surface, in two beds, one about 60 ft. below the other, which are mined through concrete lined shafts, somewhat as coal is mined. The appearance of the deposits in place is striking. They present high walls of sparkling crystalline salts, banded in nearly horizontal more or less wavy stripes of red and white, resembling a part of an immense flag. Much of the crude material is used for fertilizer after crushing only. In the refining processes the mother liquors are used repeatedly, as the accumulation of impurities in them is slow, this being considered one of the advantages which the French field has over the German. The resultant product from the refining of the Alsatian potash is a high-grade chloride.

QUANTITY OF POTASH IN ALSACE

Before the war, when the world's supply of potash was controlled by the Kali Syndikat, the mines in Alsace produced about 5 per cent of the total world's output of potash, equivalent in 1913 to about 220,000 tons of crude mixed salts containing 41,000 tons of potassium oxide (K_2O), or actual potash. The material mined carries an average of 18 per cent of potassium oxide. The deposits in Alsace are estimated to contain 300,000,000 tons of potassium oxide, enough to supply the world's need at the normal rate of consumption before the war for about 275 years.

Mr. Gale's report on the examination of these deposits has been published by the United States Geological Survey, Department of the Interior, as Bulletin 715-B, under the title "The Potash Deposits of Alsace." The report contains a valuable bibliography and is illustrated by a small map and several half-tone views. It may be obtained without charge from the Director of the Geological Survey at Washington.

Effect of Arsenic in Steel

BY P. E. MCKINNEY*

IN VIEW of the fact that the question has frequently arisen as to the effect of varying percentage of arsenic in steel, it was deemed expedient to make a few experiments in connection with the regular manufacturing operation on the effect of this element.

Two series of experiments were made. The first consisted of a comparison between a plain converter steel and steel from the same heat to which had been added 0.1 per cent arsenic. The second series was identical except that an addition of 0.5 per cent arsenic was made.

After adding the final addition to a regular converter heat, a 3½-in. diameter x 32-in. long split ingot mold was top poured from a bull ladle for the plain test. Then about 3 in. of steel was poured into a hot bull ladle of about 100 lb. capacity to cover the bottom, the metallic arsenic, mixed with several times its weight of thermit and wrapped in paper, was thrown in ladle, the ladle was then filled with steel, mixed and top poured into a similar mold. This constituted the arsenic test ingot; both series were handled in the same manner.

The ingots were stripped the following morning, sent to forge shop, heated and forged longitudinally from bottom end to ¾ in. square and cut into 6-in. lengths, a convenient size for test-bars. They were not soaked or annealed before forging, but both series worked excellently while being forged. All of the 6-in. lengths were annealed at 1,400 deg. F. and then heat treated as shown in tabulation of results. The ingots whose heat numbers are followed by the letter A are those to which arsenic was added.

The result of these tests shows practically no difference between the steel containing no arsenic and that to which arsenic has been added, and if anything the result of test shows slight superiority in favor of the steel containing arsenic. While these tests were made on small ingots and the test-piece received considerable longitudinal forging work, the results of these preliminary tests would not indicate that arsenic has

the detrimental effect to steel attributed to it by some authorities.

There is no noticeable difference in the properties of steel containing arsenic as compared with that to which no arsenic additions were made. In the pouring or forging the steel acted normal in every respect.

While it is evident from these experiments that 0.3 per cent arsenic is not injurious, as far as static testing can disclose, the fact must not be lost sight of that it is extremely hard to get rid of arsenic after it is once present in steel and if the steel is used for scrap purposes after its usefulness has ceased, there is a constant automatic augmentation of the arsenic content which will in time get beyond the limits desired. It would also be interesting to note the effect of arsenic upon shock-resisting qualities of the steel, which is of major importance where ordnance work is concerned.

Washington, D. C.

Tests for Defects in Spring Steel

During the progress of some experiments made by the Bureau of Ordnance, U. S. N., to produce suitable recoil springs from a lot of ½-in. round silicomanganese spring steel numerous breakages were obtained in the 24-hr. solid clamping test of the finished springs. In most cases the breaks showed deep seams. In torsion tests of the same material to determine the properties imparted by various heat treatments seams developed throughout the length of the specimen. In order to guard against receipt of such bars in the future it was first suggested to make a short torsion test of a fixed percentage of each lot. This would be an expensive procedure, and it was therefore decided to determine the effect of compression on a short length of the full size bar. This opened widely the seams noted in the above material and on twenty samples of material now in stock showed only three defective pieces. None of the defects was as serious as those in the ½-in. silicomanganese steel. A paragraph is therefore being added to the specifications for spring steel requiring compression of a test piece of a length 1.5 times the thickness of the bar to a length equal to the thickness of the bar. This compression is sufficient to clearly indicate serious defects.

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*Chemist and Metallurgist, Naval Gun Factory.

FIRST SERIES										
			Heat No.	C	Si	P	S	Mn	As	Remarks
			C-1,082	0.18	0.26	0.025	0.021	0.60	0.031	No arsenic added
			C-1,082A	0.19	0.24	0.023	0.030	0.62	0.089	0.1% arsenic added
Annealed	Oil Quenched	Drawn	Heat	P.E.L.	T.S.	Elong.	Red.	Rupture	Bend, Deg.	Fracture
1,400	.....	.....	C-1,082	48,300	75,300	32.50	62.30	138,900	...	Perfect cup
1,400	.....	.....	C-1,082A	43,200	72,200	33.50	62.79	125,520	...	½ cup
1,400	1,450	500	C-1,082	48,400	92,900	26.00	57.22	162,100	180	10 cup
1,400	1,450	500	C-1,082A	53,500	88,100	28.50	60.56	164,800	180	Perfect cup
1,400	1,450	1,000	C-1,082	58,600	88,400	28.25	60.56	157,800	...	½ cup
1,400	1,450	1,000	C-1,082A	53,400	85,300	31.25	64.42	179,200	...	½ cup
1,400	1,450	1,200	C-1,082	53,500	84,500	32.25	65.43	161,100	...	10 cup
1,400	1,450	1,200	C-1,082A	53,500	80,000	32.00	67.74	162,500	...	½ cup
SECOND SERIES										
			Heat No.	C	Si	P	S	Mn	As	Remarks
			C-1,123	0.13	0.25	0.019	0.048	0.57	0.065	No arsenic added
			C-1,123A	0.12	0.33	0.018	0.045	0.57	0.310	0.5% arsenic added
Annealed	Oil Quenched	Drawn	Heat	P.E.L.	T.S.	Per Cent Elong.	Per Cent Red.	Rupture	Bend, Deg.	Fracture
1,400	.....	.....	C-1,123	35,500	67,700	32.00	68.00	147,300	...	2 cup
1,400	.....	.....	C-1,123A	39,600	67,800	31.50	67.50	139,000	...	½ cup
1,400	1,450	500	C-1,123	45,800	75,100	31.00	62.20	143,800	180	cup
1,400	1,450	500	C-1,123A	45,800	77,600	25.00	58.50	141,300	180	cup
1,400	1,450	1,000	C-1,123	45,800	72,100	30.15	65.40	141,500	...	cup
1,400	1,450	1,000	C-1,123A	49,600	74,000	33.50	64.60	143,700	...	cup
1,400	1,450	1,200	C-1,123	42,700	69,300	32.00	70.40	157,300	...	cup
1,400	1,450	1,200	C-1,123A	48,800	73,400	33.50	69.50	153,600	...	cup

Wire-Baking Electric Oven

The application of electric heat to the process used in making steel wire has given such excellent results and is so economical of operation that it should be of interest to operators of all plants where wire drawing is done.

In the manufacture of steel wire the rods as received from the hot rolls are pickled in acid to remove the scale, dipped in lime-water to neutralize the excess acid, and then baked, to drive out the "acid in the steel," the amount of baking depending on how small the wire is to be drawn. If it is to be drawn only one or two holes, a short bake is enough, but for five or six holes the stock must be baked for several hours to withstand the severe drawing. The wire may be, in some cases, additionally heated to dry off grease or oil, or for a low anneal.

At the plant of the Halcomb Steel Co., at Syracuse, N. Y., where the following operation figures were obtained, there are two electric drying ovens, using G.E. apparatus, 16 x 6 x 6 ft. with 96-kw. connected, used for drying off the wire, at a maximum temperature of 600 deg. F., the other 40 x 6 x 6 ft. with 234-kw., for drying "acid in the steel," the wire being in the oven from 1 to 10 hr. at an average temperature of 350 deg. F. Coke and steam heated ovens are also used to do the same work. Thus it is possible to obtain comparative operation costs.

The following data show the cost of operation of the electric and coke oven for a considerable period of time on the ovens used in drying grease and oil from the steel, with normal production, and also the figures applicable if full production had been possible. The work of electric power in these tables is figured at \$0.95 per kw.-hr.:

ELECTRIC		
	Normal	Max.
Cost of power, net ton steel.....	\$5.087	\$1.19
Annual charges per net ton.....	7.839	.727
Total cost per net ton.....	\$12.926	\$1.917
COKE		
Cost coke per net ton.....	\$0.921	\$0.171
Annual charges per net ton.....	21.368	1.983
Total cost per net ton.....	\$22.289	\$2.154

The efficiency of the electrically heated oven as actually operated amounts to 3.73 lb. per kw.-hr., or 535 kw.-hr. per ton, the maximum figures being 16 lb. per kw.-hr., or 125 kw. per ton.

The figures on the operation costs of the kiln for drying "acid in the steel" also show a greater economy in the use of the electric oven.

ELECTRIC		
	Normal	Max.
Cost power, per net ton steel.....	\$0.787	\$0.515
Annual charges per net ton.....	.648	.187
Total.....	\$1.435	\$0.702
COKE		
Cost coke per net ton steel.....	\$0.253	\$0.146
Annual charges per net ton.....	1.766	.510
Total.....	\$2.019	\$0.656

As operated, the efficiency of the electric oven is 24.1 lb. per kw.-hr., or 83 kw.-hr. per ton, while the maximum production figures would be 36.8 lb. per kw.-hr., or 54.4 kw.-hr. per ton.

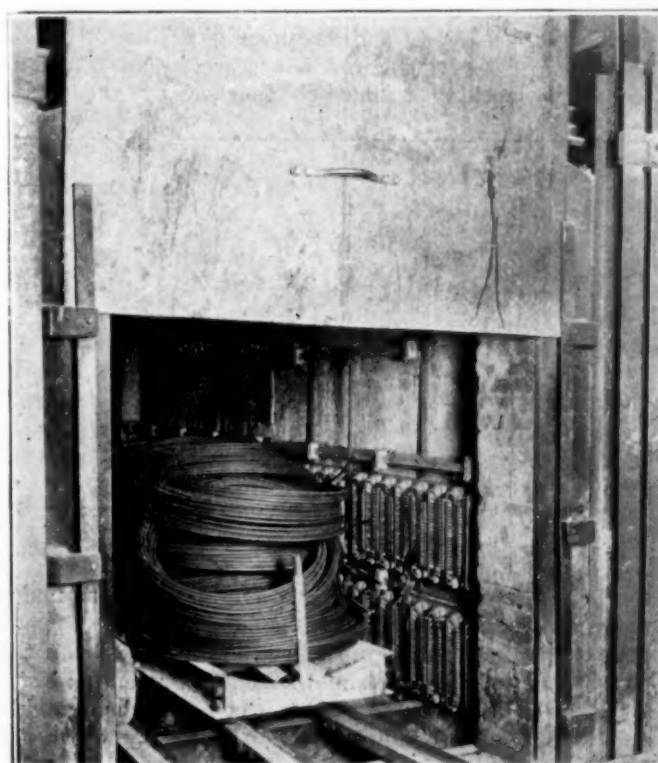
The use of an electric oven permits accurate duplication of results of the finished product due to the perfect temperature control, whereby the operating temperature can be quickly changed when desired.

Wedge Optical Pyrometer

Accurate measurement and control of high temperatures are essential to the production of the best results in the metallurgical and many other industries. It will soon be considered as absurd for a workman to attempt to estimate a temperature by the unaided eye as to attempt to measure up his work by the eye alone when rules and gages are available. The demand for a simple, portable instrument for temperature measurement, which can be used without long training or expert technical qualifications, has been met by the Wedge optical pyrometer, a reliable and practical instrument, requiring no accessories of any kind, which cannot get out of order, and may be placed with confidence in the hands of any intelligent workman.

This pyrometer can be used whenever the object to be examined shows a distinct coloration, that is to say, for any temperature above 525 deg. C. The size of the object or its distance makes no difference whatever to the reading.

As shown in the accompanying illustration, the instrument consists of a brass tube, furnished with a small achromatic telescope, so arranged that the objective of the telescope focuses the image of the heated body on a movable prism placed inside the tube. The eye-piece of the telescope then reveals the magnified image on the prism to the observer. There is a suitable shield provided, to prevent exterior light reaching the eye. At one side of the tube is a milled head, actuating a rack-and-pinion which moves the prism through the field of vision. The prism is made of specially prepared dark glass, so arranged that it cuts off the light emitted by a heated body at different temperatures. For example, in looking at a heated bar of iron, as the thicker part of the prism comes gradually into the field of vision, the bar appears gradually darker and darker in color, until at a given point the image entirely disappears; this point gives the actual temperature. On



INTERIOR VIEW OF WIRE-BAKING ELECTRIC OVEN

looking at the scale on the side of the instrument, the pointer will be seen at (say) 1,000 deg. C. A similar operation takes place in every estimation. Naturally a little practice is required to decide the exact moment when the color disappears, and here, of course, the practiced eye of the operator comes into play.

The first readings will probably be within 20 deg. C., afterwards to 10 deg. C. or less. When great accuracy



WEDGE OPTICAL PYROMETER

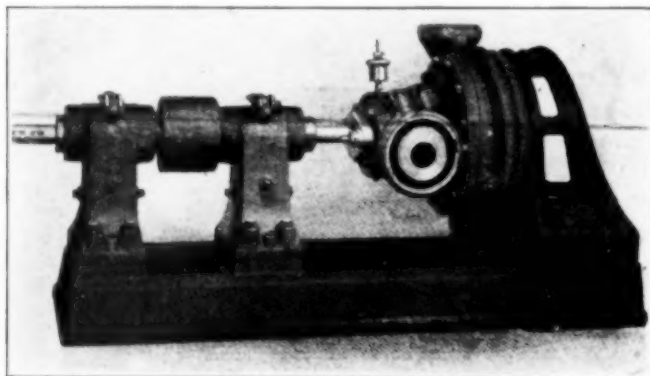
is required, and the heated body or furnace aperture is small, it is advisable to mount the pyrometer on a stand. The accuracy of the Wedge optical pyrometer has been demonstrated by trial by eminent experts under test conditions. It is introduced on the market by the Rohde Laboratory Supply Co., of New York City.

Non-Corrosive Centrifugal Pump

The Duriron Castings Co., of Dayton, Ohio, has placed on the market an improved Duriron single-stage centrifugal pump. Every part of the pump that comes in contact with the liquid handled is of Duriron, and thus resists virtually all acids, alkalis and salts as well as erosion.

Probably the greatest single source of trouble, certainly the most constant one, in acid pumps has been the limited service possible to obtain from the packing.

Contact of the corrosive handled with the packing made its life short, and frequent repacking of acid pumps has been considered a necessary evil. In this pump the packing cannot be touched by the liquid



DURIRON CENTRIFUGAL PUMP

carried, inasmuch as the suction is always under vacuum while the pump operates.

Operators should be instructed, however, to drain the pump when not in service and when the vacuum is lost.

All parts of the pump proper may be reached quickly and easily by loosening the bolts, removing the cover plate, and pulling out shaft and runner, and this without disturbing the suction and discharge connections.

By means of a cage gland the lubricant is forced from the container always and only in the direction of the packing.

The impeller is of such design that in case the discharge connections break and the head be reduced, the impeller will not admit more liquid than the motor will handle, so it automatically prevents damage to motor in direct connected installations. Helical vanes in impeller admit a free flow of liquid, consequently there is the least possible erosive action in operation.

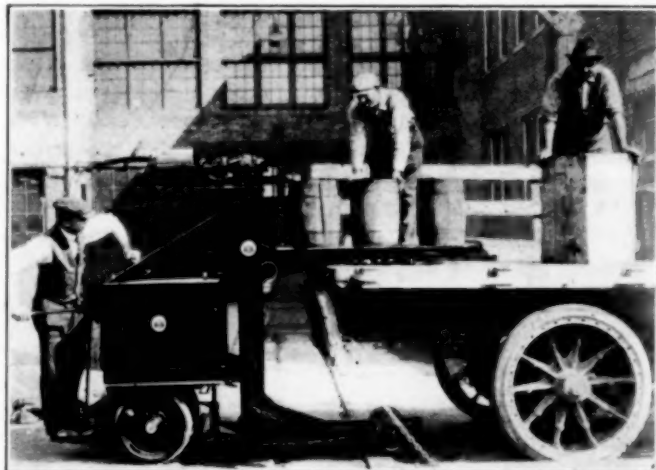
The suction and discharge connections are adjustable, and this pump will accommodate itself to any position or angle that may be necessary or desirable under any conditions of installation.

Where the liquid handled carries solids in suspension or material not suitable for the closed type of impeller, an open type that will handle a large percentage of solids may be used.

All parts of the pump are ground to gage and are therefore interchangeable.

New Truck to Save Space, Time and Man Power

A new industrial truck which, with its own power, elevates the loads to sufficient heights to put material in box cars, stock rooms or trucks, without rehandling, has been developed by the Lakewood Engineering Co.,



Cleveland, Ohio. Because of its ability to perform all the functions of a tiering machine as well as those of a load-carrying storage battery truck, the new machine is called the "Tier-Lift." It serves practically every purpose of a load-carrying industrial truck. This apparatus will, with its own power, elevate a 2-ton load to a height of 76 in., or to any intermediate height.

A 4-wheel steer permits turning in a circle 92 in. in radius. This permits easy turning in narrow aisles, or congested parts of a plant, and gives easy entrance into box cars.

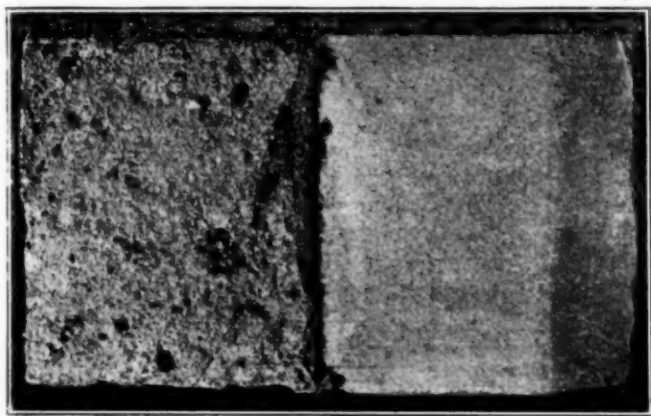
There are three speeds forward and three speeds reverse. The controller handle is conveniently located for operation for travel in either direction. The lifting mechanism is operated by means of a specially designed controller with one speed in either direction. The lifting is done by means of high-efficiency steel worm screws. A separate motor is used to raise the load.

The load platform is carried by a cantilever type support and the load is balanced over the load-carrying wheels. Ball bearings are used throughout and by a special design the friction losses in elevating and lowering the load platform are practically eliminated.

Acid-Proofing and Hardening of Concrete

The chemical division of the U. S. S. Lead Refinery, Inc., is producing a new solution for the hardening and acid-proofing of concrete surfaces. The manufacturing operations are carried on at the company's lead refinery located in East Chicago, Ind. This solution has become a product of intense interest to manufacturers of chemicals, particularly those industries where acids or oils enter into the processes, mainly because the tests made up to the present time and still under way show that ordinary concrete is rendered practically inactive to acid solutions and oils.

The concrete surface at the time of each treatment must be free from dirt, oil or grease, and must be dry



TEST WITH ACETIC ACID

and set at the first instance of application. One part of proofing solution is diluted with two parts of water and applied with a brush. After allowing to stand for twenty-four hours the second coat is put on, consisting of equal parts of proofing solution and water. This is allowed to stand for twenty-four hours and a third coat is applied, consisting of two parts of proofing solution to one part of water. When the concrete is very porous a fourth application of straight proofing solution is recommended.

At the completion of the process the surface is dried and flushed with water.

When the solution is thus brought in contact with the concrete, it precipitates acid-resisting compounds into the pores of the mass, causing the new surface to become an entirely different chemical composition from the original concrete, this effect penetrating to a depth of about $\frac{1}{2}$ in. This new surface chemically formed is hard and flint-like in structure and is not attacked by acid solutions or oils. It is also very hard, being resistant to wear, as when put on concrete floors.

It is now in use on floors subjected to acid slops at the Willard Storage Battery Co. and is being considered by a number of chemical firms for the construction of acid tanks. Should it prove successful in the latter case, the benefit to the chemical engineer over the present method of lining these tanks or silos with acid-proof brick is obvious.

The accompanying illustration shows a comparison between a treated and untreated slab of concrete which has been immersed in a 20 per cent acetic acid solution over a long period of time. A complete series of tests on all of the acids is now under way at the Research Laboratory of the U. S. S. Lead Refinery, Inc.

Roto Piston Pump

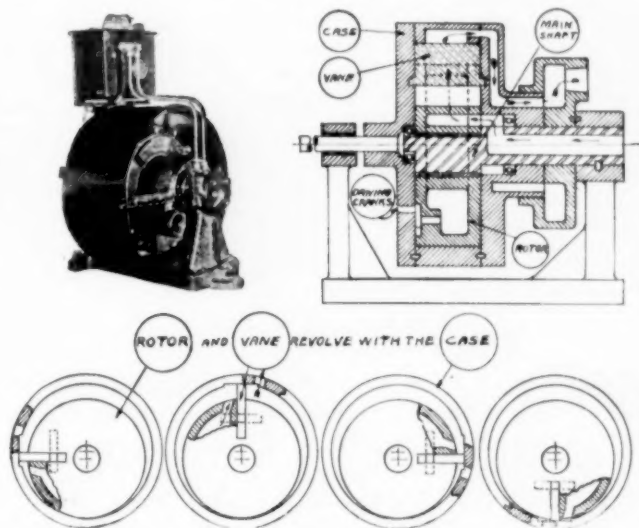
A totally different application of eccentric motion, obtained through the use of the "Roto-Piston," has been introduced by the Crescent Pump Co., of Detroit, in commercial vacuum and pressure pumps. Manufacturing high-duty, high-speed pumps, direct-motor driven, it has been sought to make durability the outstanding feature. By its ingenious construction and operation this has been so far accomplished as to justify a guaranteed length of life for each pump.

The vacuum pump will pull within $\frac{1}{2}$ in. of mercury pressure under commercial conditions and down to $\frac{1}{16}$ in. in special use, according to the manufacturer's guarantee. Reversed as a compression pump, it will give 20 lb. to the sq.in.

An inner and an outer casing revolve at the same speed, greatly reducing friction, as all contacts are rolling contacts. Flywheel vanes, valves and gears are eliminated. A single sliding vane accomplishes a continuous sealing with an oil film protection, being positively held by centrifugal force. It rotates with the inner and outer casings and at almost the same speed, having a sliding contact area of less than 3 in. on the outer casing.

The accompanying diagram illustrates the motion of the pump. One casing revolving on an eccentric alternately creates and fills a space into which air is drawn. At rapid revolution the action is continuous.

An important feature in the pump's long life is the compensation which is automatically made for wear.



ROTO PISTON PUMP

This wear takes place almost entirely in the bearings, which are standard ball and roller bearings. Because of this automatic compensation adjustment is unnecessary and leakage is easily prevented.

Careful balancing of all rotating parts practically eliminates vibration. The complete pump is compact, light and self-air-cooled, and can be easily moved. Heavy foundations are not required.

Porcelain Token Money

The city of Meissen and other towns have ordered porcelain coins for local use, to solve the small-change scarcity and obviate the present unclean and easily tearable paper currency. Germany is said to be about to introduce porcelain small-change coins.

Synopsis of Recent Chemical & Metallurgical Literature

Status of the Aluminum Industry in Germany During and After the War.—Among the industries which were most extensively developed in Germany during the war that of aluminum occupies one of the first places. L. DESCROIS has published in the April, 1920, issue of *Revue de Métallurgie* an article on this subject, of which the following is an abstract:

Up to 1914 the role of aluminum was quite unimportant, but the necessities of war required its extensive use by all the belligerent nations and especially by the Central Powers.

Aluminum alloys were extensively used in aeronautics and automobile construction; the iron industry used great quantities of a ferro-aluminum with 10-20 per cent aluminum and 3 per cent carbon as a deoxidizer; an aluminum alloy was used for the manufacture of fuses and even for small change money (pfennigs). Aluminum metal was used as a copper substitute for electric conductors, in fermentation industries and in nitric acid plants. In Austria aluminum powder entered into the manufacture of explosives.

Germany has no bauxite or cryolite deposits, except small quantities of very poor quality in Hesse near Frankfurt-a-M., and previous to the war 95 per cent of the bauxite treated in Germany was imported from France. The aluminum industry was monopolized by two companies; namely, (1) The Aluminium-Industrie Aktien-Ges. of Neuhausen (Switzerland), with plants at Neuhausen (4,000 hp.) and Chippis (50,000 hp.), both in Switzerland; at Rheinfelden, Germany (5,000 hp.), Lissa, Silesia, and Lend-Gastein (15,000 hp.), in Austria, and (2) Gebrüder Giuliani of Mannheim, with plants at Lissa, Silesia, and Martigny, Switzerland (3,000 hp.).

These two companies controlled the entire production of the three states and during 1913 produced 12,000 tons of aluminum—i. e., 17.6 per cent of the total world production. Of this amount Neuhausen and Chippis produced 8,000 tons and Martigny 700 tons, so that the aluminum production in Germany in 1913 was not over 2,500 tons, although its consumption was about 12,600 tons—i. e., 18.5 per cent of the total world consumption.

With the outbreak of the war the supply of raw material was completely cut off and they had to rely on Switzerland for the needed aluminum, which they were able to obtain in exchange for coal. Thus during the second half of 1914 Germany imported from Switzerland nearly 4,000 tons of aluminum, about 9,000 tons in 1915 and more than 10,000 tons during 1916. This contributed to an extraordinary development of the aluminum industry in Switzerland, where in 1917 the production reached 20,000 tons, of which the greater part went to Germany. But even the increase in import did not meet their needs, and so the Germans started to build their own plants as early as 1915. The first aluminum war plant was put in operation at the end of 1915, using as raw material the timely discovered bauxite in the Carso region along the Adriatic Sea of the then Austrian Empire. From

that region about 50,000 tons of bauxite was mined in 1916, besides the supply of the formerly known bauxite mines in Hesse, near Frankfurt-a-M. The need of aluminum encouraged extensive exploration for bauxite, with the result that rich deposits were discovered in Dalmatia and Hungary. Those of Hungary are especially valuable and it has been estimated that there is in reserve about 10,000,000 tons in the Bihar district alone, besides appreciable quantities in the valleys of Jad and Galbina and near Rey, Sonkolyos and Tizfalu.

The Bihar bauxite analyzes Al_2O_3 , 53-60 per cent; SiO_2 , 1.67 per cent; Fe_2O_3 , 20-35 per cent, TiO_2 , 1.5-3 per cent, and in 1915 as much as 50,000 tons was mined from this newly discovered field. It is also said that there was obtained in 1916 from the Oderberg district about 40,000 tons of bauxite analyzing Al_2O_3 , 54 per cent, SiO_2 , 2.6 per cent, Fe_2O_3 , 26 per cent, TiO_2 , 4 per cent. The Dalmatian and Carso mines, especially those of the islands of Veglia, Loparo and around St. Gregory, were worked with Russian prisoners. In May, 1916, it was stated that the German Norton Co. discovered near Laybach great quantities of very pure bauxite, but it would seem that not much use has been made of it, because the official figures given indicate that only 660 tons was mined in 1916 and 4,000 tons in 1917.

Great efforts have been made to recover aluminum from clay or from a mixture of clay with bauxite or cryolite, but it is certain now that all these efforts failed completely.

The importance of aluminum proved such that by the middle of 1916 the Imperial Finance Department approved the formation of three special aluminum companies; namely, (1) Erftwerk Aktien Gesellschaft, (2) Vereinigte Aluminium Werke Akt. Ges. and (3) Innwerk Bayerische Aluminium Akt. Ges. Up to now three new plants have been installed—namely, at Knappsack, near Cologne, by the first named company, and at Bitterfeld and Niederlausitz, by the Vereinigte Aluminium Werke. All these plants get their power from central stations using lignite as fuel. There are now in course of construction two plants by the Innwerk company to use respectively 50,000 and 75,000 hydro-electric hp. It is stated that when all these plants are in full operation their annual production will be 45,000 tons.

Aluminum is destined to occupy a very important place in industry, due to the great variety of applications to which it may be suited and to the relative abundance of the raw material.

The following table giving the production in thousands of tons for 1913, 1917 and after the war, shows the rapid increase in the aluminum industry in the main producing countries:

ALUMINUM PRODUCTION, THOUSANDS OF TONS						
Countries	—1913—		—1917—		After the War	
	Per Cent	According to Mineral Industry	According to Engineering & Mining Journal		According to R. Troger	Per Cent
United States.....	22.5	32.50	90.7	65	65	31.70
France.....	18.0	26.00	20.0	20	20	10.35
Great Britain.....	7.5	10.80	6.0	12	12	6.20
Germany.....	1.0 (?)	1.45	6.0	12	40	20.70
Austro-Hungary (now in Hungary and Jugo-Slavia)	1.0 (?)	1.45	5.0	5	.....	.....
Switzerland.....	12.0	17.35	15.0	20	25	13.00
Canada.....	5.9	8.50	14.3	8	8	4.15
Italy.....	0.8	1.15	7.0	7	7	3.60
Norway.....	1.5	2.15	18.0	16	16	8.30
Total	69.2	99.90	176.0	153	193	100.00

Mr. DESCROIS passes in review at length the prospects for the after-war German industry, and shows that these prospects are very gloomy, due to the low quality of raw material, the percentages of silica and titanium oxide being detrimental, and to the high cost of power. He analyzes the cost prices, especially those given by Dr. Hans Goldschmidt and Dr. C. Dux, both authorities on the aluminum industry, and concludes with the statement that even on the basis of the German calculations Germany will not be able to compete with the American, French and Swiss producers.

Enamels for Sheet Iron and Steel.—In response to the demand for a general treatise dealing with the technology of the manufacture of vitreous enamels for sheet iron and steel, the Bureau of Standards has issued Technologic Paper 165, by J. B. SHAW. This subject has not been treated adequately in any previous publication.

From the standpoint of mechanical equipment the sheet-iron and steel enameling industry has been probably the most progressive of all ceramic industries in the United States. The presses and machinery used for working the steel and forming the chapes are unsurpassed in ingenuity by those used in any other industry, and are constantly being improved. In this respect the sheet-metal enameling industry of this country has led the world. In the strictly ceramic lines of the industry having to do with the preparation and application of the enamels, progress has been less rapid. Up to a few years ago there was very little work carried on, and this little was seldom reported in print. Recently there has been a decided change in this respect. Representatives of the enameling industry have been joining the ceramic technical societies, have been contributing rather liberally to the journals of these organizations, and have been showing a decided interest in developing the technology of sheet-metal enameling. The leading manufacturers of the country are realizing that the sheet-iron enameling industry has reached the limit of development possible so long as it depends upon formulas rather than upon men with technical training which will enable them to improve and manipulate these formulas to meet varying conditions.

In collecting data for this paper an effort has been made to obtain reliable and authentic information wherever available and to correlate it in such a manner as to shed some light on the problems encountered by enamellers. The treatise is a compilation of data dealing with the subject of enameling from various publications, from the note book of the author, from the files of the Bureau, and from the experience of men engaged in the enameling industry in this country.

Among the subjects dealt with in connection with the properties and preparation of steel for enameling are physical and chemical requirements, sand blasting, treatment preliminary to pickling and methods of pickling. A chapter is devoted to the properties of the raw materials used in compounding enamels. The relations between chemical composition and physical properties of enamels are discussed fully. The procedure used in the preparation, applying and firing enamels is described in detail. The calculation of enamel formulas is fully explained and examples are given. The physical properties of enamels are dealt with in some detail and resistance of enamels to chemical action is fully discussed.

Recent Chemical & Metallurgical Patents

British Patents

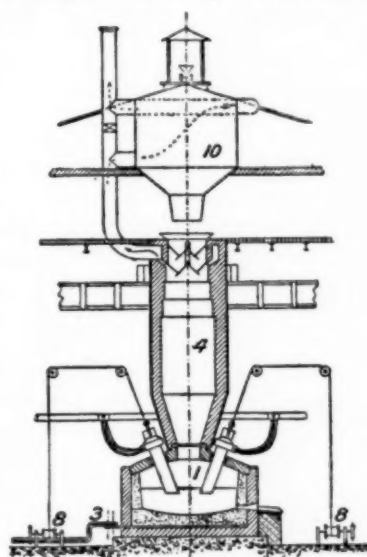
Complete specifications of any British patent may be obtained by remitting 25c. to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Sulphur.—Crude sulphur is purified by melting or dissolving in a suitable solvent, such as carbon bisulphide, and filtering through precipitated and ignited alumina or magnesia or mixtures thereof, or through ignited bauxite or magnesite or mixtures thereof. Solutions of sulphur obtained by extracting spent oxide with a solvent may be similarly treated. When exhausted, the filtering material is revived by treating with steam or with a solvent for sulphur and then igniting. (Br. Pat. 140,844—1919. J. J. HODD, London, May 27, 1920.)

Extracting Copper.—Lyes, used for lixiviating cupriferous pyrites, flow from a cock on to waste iron plates in a wicker-work basket, suspended above a tank, whereby a thin film of copper is allowed to deposit on the iron. The copper-coated iron is transferred to a tank, containing cupriferous solution or lye to allow the film to increase in thickness. Finally, the copper is removed by means of a flexible blade, washed and dried, when it is ready for use for melting down, for electric refining, or for the manufacture of copper sulphate. The product contains 98 to 99 per cent of copper and a very low proportion, 0.35 per cent, of iron. (Br. Pat. 141,290—1919. H. P. SOULIE-COTTINEAU, Paris, June 9, 1920.)

Electrode Furnaces.—A furnace of known type, for the manufacture of hydraulic lime and slow or quick-setting cements by fusion of the ingredients, is provided with electrodes

which dip into a crucible 1 and are adjusted by winches 8. Above the crucible is a cylindro-conical shaft 4 into which the materials are fed from a preheater 10. The hearth of the crucible is made of rammed conducting-material, such as earth, resting on a conducting-plate connected with the conductor bar 3. (Br. Pat. 141,142—1919. M. L. BOILOT and J. DAUDIGNAC, France, June 9, 1920.)



ELECTRODE FURNACE

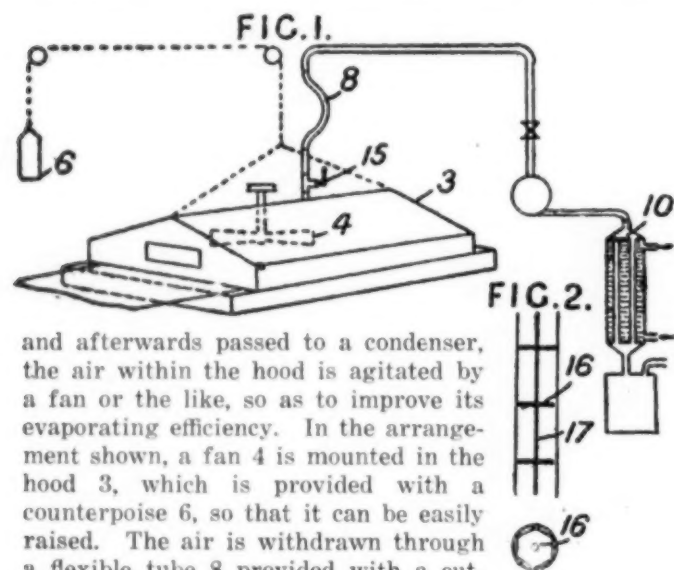
Purifying Oils.—Finely divided calcined phosphate is added to the oil, which may be stirred and kept at 40 to 50 deg. C. On standing, the mixture separates into layers, which are tapped off. The phosphates may be added in a dry state or suspended in water. A calcined natural phosphate such as apatite is used. Products obtained by calcining a mixture of an artificial phosphate,

such as tricalcium phosphate, with a metallic salt of a volatile acid or other substance contained in crude phosphates, e. g. halogen compounds or carbonates, may also be employed. The phosphate may be used in conjunction with other refining-agents. The calcined phosphate may be treated with acids, alkalis or other reagents. The precipitate obtained in treating the oil may be dried and used as a fertilizer. (Br. Pat. 141,028—1919. K. STIANSEN, Sanderfjord, Norway, June 2, 1920.)

Barium Carbonate.—Finely-divided barium carbonate is obtained by treating witherite or artificial carbonate with a fused salt, such as sodium chloride, which dissolves it. A small quantity of an oxidizing agent, such as sodium nitrate, may be added, or air may be blown through to oxidize iron compounds, and any sediment or scum is removed; or the fused mass may be submitted to a reducing atmosphere in the furnace. The material is then discharged into water, which dissolves the solvent salt, leaving the barium carbonate in a finely-divided state. (Br. Pat. 141,925—1919. H. LANGWELL, Stockton-on-Tees, June 23, 1920.)

Steel.—In making steel from scrap, a small part of the charge is melted in an open-hearth furnace with a carburizing agent whereupon the main part of the charge, preheated to about 800 deg. C., is added. Alternatively, the molten carburized metal may be added to the main charge in a separate furnace. The process may be worked as a continuous one. The preheating may be effected in containers erected over the hearth, or portable and traveling preheaters may be used. Metal and slag may be withdrawn from the furnace by means of a siphon. (Br. Pat. 141,956—1919. G. A. JARVIS, Wellington, Shropshire, June 23, 1920.)

Recovering Volatile Solvents.—In an apparatus for recovering volatile solvents, especially in the rubber industry, in which air is drawn through a closely-fitting hood covering the substance under treatment

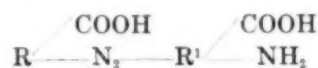


and afterwards passed to a condenser, the air within the hood is agitated by a fan or the like, so as to improve its evaporating efficiency. In the arrangement shown, a fan 4 is mounted in the hood 3, which is provided with a counterpoise 6, so that it can be easily raised. The air is withdrawn through a flexible tube 8 provided with a cut-off valve 15 connected to the starting lever of the machine, by which it is closed when the material is not being drawn through the hood. From the hood the air passes to a condenser 10. It may be compressed before passing to the condenser. The condenser tubes may be of circular cross-section provided with hexagonal baffles 16 on a central rod 17, as shown in Fig. 2, to collect entrained liquid. (Br. Pat. 141,210

—1919. D. V. PLUMBRIDGE, South Kilworth, Warwickshire, June 9, 1920.)

Artificial Threads.—To obtain very fine threads from viscose by the drawing-out process, the viscose used is prepared from a "very weak hydrated cellulose," and the original relatively-thick threads are stretched, while undergoing coagulation, in a slowly acting precipitating liquid, such as a 1 per cent sulphuric acid solution. After leaving the coagulating bath the threads are wound on reels revolving in a 2 to 4 per cent solution of sulphuric acid, by which they are finally hardened. (Br. Pat. 141,041—1919. GLANZFADEN AKT.-GES., Petersdorf-in-Riesengebirge, Germany, June 2, 1920.)

Secondary Disazo Dyes.—Secondary disazo dyes are prepared by diazotizing an aminoazo dye of the general formula



(R, R' = aryl radicals, substituted or not), and coupling with an aminonaphthol sulphonic acid, an acetylaminonaphthol sulphonic acid, or a pyrazolone containing a carboxyl group or a carboxyl group and a hydroxyl group in its aryl residue. The products are mordant dyes, dyeing wool in acid baths shades which become yellow to red or green-blue when after-chromed, and give similar tints when chrome-printed on cotton. Examples are given of the preparation of dyes from the following parent materials:—4-aminoazobenzene-3:3'-dicarboxylic acid and 1-2'-carboxyphenyl-3-methyl-5-pyrazolone; 4-aminoazobenzene-3:3'-dicarboxylic acid and 1:8:2:4-aminonaphthol disulphonic acid; 4-aminoazobenzene-5'-sulpho-3:3'-dicarboxylic acid and 1-phenyl-5-pyrazolone-3-carboxylic acid; 4-aminoazobenzene-5'-sulpho-3:3'-dicarboxylic acid and 1:8:3:6-acetaminonaphthol disulphonic acid; 4-aminoazobenzene-2:3'-dicarboxylic acid and 1-2'-oxy-3'-carboxy-5'-sulphophenyl-3-methyl-5-pyrazolone; 4-aminoazobenzene-3:4'-dicarboxylic acid and 1-2'-oxy-3'-carboxyl-5'-sulphophenyl-3-methyl-5-pyrazolone. (Br. Pat., 141,401—1919. SOCIETY OF CHEMICAL INDUSTRY, Basel, Switzerland, June 9, 1920.)

Aromatic Amines, Phenols, etc.—Coloration is removed from, or its development prevented in, aromatic amines or phenols or their sulphonic or carboxylic acids by treatment with a small proportion of a hydrosulphite or sulfoxylate, any excess of hydrosulphite or sulfoxylate being finally removed. Thus, a discolored finished product is dissolved or suspended in a solvent, decolorized by adding a small proportion of hydrosulphite or sulfoxylate, and then isolated from the solution or suspension in the usual way; or discoloration may be removed or prevented in a product by adding a small proportion of hydrosulphite or sulfoxylate to the parent materials used in the manufacture thereof. Examples are given of the treatment with sodium hydrosulphite of β -naphthol, benzidine, the solutions of sodium sulphanilate or naphthionate obtained in the manufacture of these acids, or the acidified alkali melts obtained in the manufacture of phenols such as β -naphthol, H-acid, or γ -acid; an example is also given of the addition of sodium hydrosulphite to mixtures of caustic soda solution and sulphonic acids, e.g. aminosulphonic acids, before heating in an autoclave to produce the corresponding phenols. (Br. Pat. 141,440. SOUTH METROPOLITAN GAS CO., London, and H. STANIER, Stoke-on-Trent, June 9, 1920.)

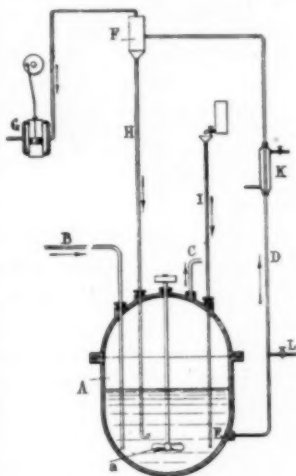
Acid- and Alkali-Proof Aluminum Ware.—Aluminum, aluminum alloys or vessels coated or lined with aluminum are rendered acid- and alkali-resisting by powdering the preliminarily roughened surface with finely-ground carbonate of lime (chalk, mussel shells, etc.), then heating in a furnace to about 550 deg. C. and binding the coating to the aluminum by rolling, pressing, etc. (Br. Pat. 140,069—1919. METALLINDUSTRIE SCHIELE & BRUCHSALER, Hornberg, Baden, May 12, 1920.)

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Purifying Brine.—In the purification of brine for use in electrolytic cells, the calcium sulphate is usually converted into calcium carbonate by means of sodium carbonate. Thus there is formed in the brine an equivalent amount of sodium sulphate, which oxidizes the graphite anode during electrolysis and accumulates in the cell until it interferes with the efficient operation of the latter. For the removal of this sodium sulphate, FRANK G. WHEELER, of Appleton, Wis., has devised an apparatus in which the impure brine is cooled by flowing over pipes containing refrigerated purified brine. The sodium sulphate which crystallizes out adheres to the pipes and has to be removed by a mechanical scraper. The mixture of brine and crystals passes to a settling tank, from the bottom of which the crystals are discharged into a centrifugal drier. The cold purified brine serves to cool the impure brine in a preliminary heat-interchanger. (1,342,519; assigned to Bleach Process Co.; June 8, 1920.)

Acetaldehyde From Acetylene.—In the preparation of acetaldehyde from acetylene, the catalysts used tend to polymerize a part of the aldehyde or to transform it into aldol, crotonic aldehyde, etc. The solution of this problem is the continuous removal of the aldehyde as rapidly as formed. Many methods have been proposed for the accomplishment of this result. The most recent is that of ALFRED GUYOT, of Salindres, France. An apparatus has been devised in which the aldehyde is extracted continuously by the use of a vacuum, which does not, however, act in such a manner as to draw the acetylene gas through the reaction vessel without being fixed. The reaction vessel A, into which the acetylene enters through tube B, is provided with a powerful agitator a. The residual gases escape through C. Under the influence of the vacuum pump G circulation of the liquid through tubes D and H is maintained in the direction indicated by the arrows. The rise of liquid in D may be assisted by introducing air at L or by heating at K. Arriving at F the acetaldehyde evaporates due to the diminished pressure, and the aldehyde-free liquor returns to the reaction vessel through H. Water entering into reaction or lost by evaporation is replaced through I. (1,343,715; assigned to Compagnie des Produits Chimiques d'Alais et de la Camargue; June 15, 1920.)



Porcelain.—Porcelain has heretofore been made of a mixture of clay, a flux, such as feldspar, and silica, these ingredients varying somewhat in proportion and chemical purity. The silica has been used as a sort of refractory skeleton or body during the vitrification of the other ingredients. CHRISTIAN DANTSIZEN, of Schenectady, N. Y., has discovered that the mechanical and insulating properties of porcelain may be improved by using in place of silica, in part or entirely, a stable refractory material, such, for example, as an oxide of zirconium, titanium, aluminum, magnesium, glucinum or thorium. A typical porcelain mixture in a "green" state before firing may consist of 45 parts clay, 35 parts feldspar and 15 parts flint. When a porcelain having the above composition and prepared in the usual manner is heated to 800 deg. C. and then plunged into water it becomes highly fragile so that it can be readily broken apart between the fingers. When the silica in such a composition is replaced by a refractory metallic oxide—for example, zirconia or zircite cement—the finished porcelain can be heated to 800 deg. C. and can be plunged into water without losing its mechanical strength. The modulus of rupture of a sample of porcelain was found to be 4,390; the modulus of rupture of a zirconia porcelain similarly prepared was found to be 7,400. The electrical resistance of ordinary porcelain and zirconia porcelain are closely the same at ordinary temperatures, but at elevated temperatures the electrical resistance of zirconia porcelain is greater than that of ordinary porcelain; for example, at 286 deg. C. the electrical resistance of ordinary porcelain was found to be 0.832 megohms, while at this temperature the resistance of zirconia porcelain is 2.43 megohms. The new porcelains are also less porous than silica porcelain. (1,343,040; assigned to General Electric Co.; June 8, 1920.)

Treating Waste Sulphite Liquor.—A process for the recovery of SO₂ from waste sulphite liquor which leaves the liquor in a favorable condition for fermentation, etc., is described by AUGUST SCHAEFER, of Portland, Ore. The waste liquor as discharged from the blow pit of the digester flows in a thin film over a series of vertically stacked steam-heated coils contained in a chamber in which a vacuum of 5 to 6 in. is maintained by a barometric jet condenser. The heat and diminished pressure facilitate the escape of the SO₂, which is recovered by absorption in water in a suitable tank situated between the evaporating chamber and the condenser. The remainder of the liquor is discharged through the bottom of the evaporating chamber, neutralized and cooled. It may then be fermented for the production of alcohol. (1,342,721; assigned to Northwest Process Co.; June 8, 1920.)

Halogenation in Side Chain of Aromatic Compounds.—Sulphur chloride (or sulphur) in the presence of acetyl chloride forms an efficient catalyst for the substitution of a halogen in the side chain of an aromatic compound. Thus, in the preparation of benzal chloride, 225 parts of dry toluene is mixed with 4.5 parts of sulphur chloride and 4 parts of acetyl chloride. After heating to 100 deg. C. dry chlorine is introduced rapidly and the temperature raised to 180 deg. C. When the liquid has a specific gravity of 1.272 the flow of chlorine is stopped. The liquid will be found to contain about 245 parts of benzal chloride. The preparation of benzyl chloride and benzotrichloride is also discussed. (1,345,373; LUCAS P. KYRIDES, of New York, assignor to General Chemical Co.; July 6, 1920.)

Current Events

in the Chemical and Metallurgical Industries

Chemical Exposition Greater Than Ever

With accepted applications for space near the 400 mark—a new record—the preliminary details of the Sixth National Exposition of Chemical Industries in Grand Central Palace, New York City, Sept. 20 to 25 inclusive, make certain that the show will outclass the five previous ones. The program, aside from the exhibition proper, is also the most important that has ever been scheduled.

On the afternoon of Thursday, Sept. 23, the Chemical Engineering Symposium will take place. The American Institute of Chemical Engineers will hold a meeting in the Palace in the afternoon, and papers of great interest will be read. In the evening the engineers will have a dinner at the Technology Club.

Three other symposiums will be held during the week. One will be on Fuel Economy, one on Materials Handling, and one on Industrial Management. The Fuel Handling Division and the Materials Handling Division have developed such progress that it is necessary to give each a separate section at the coming Exposition. Important topics will be discussed on the days these two divisions meet.

Entering as it does practically every phase of industry, the Exposition offers a remarkable opportunity to the manufacturer and business man to see what has been accomplished since American chemists entered the field in earnest, or during the war. Discoveries that have revolutionized many manufacturing processes have been made. These have increased production and improved the quality of the merchandise and have resulted in those who have spent money in research finding that the investment paid.

A feature of this year's Exposition will be moving pictures. These will illustrate fields where American chemistry has advanced, and the subjects will be placed before the public in a manner that will enable the lay public to appreciate the difficulties that have been overcome during the past five years.

Research and experiments during the past five years, though successful to a wonderful degree, have proved that despite all that has been accomplished there is still a big field to be explored in dyes, pharmaceuticals and various organic products. American chemists are rapidly solving these problems, but they have no easy task. However, the United States has reached out and grasped the pilot's wheel in world chemistry and its chemists are determined that it will never again relinquish its leadership.

Chemical Merger Reported Consummated

It is reported that the much-rumored combination of the Big Four, the General Chemical Co., The Barrett Co., the National Aniline & Chemical Co. and the Semet-Solvay Co., has actually taken place and that only minor details now remain to be taken care of before the public announcement will be made.

The capitalization of the new company will be about \$200,000,000. It is stated that Barrett Co.'s stock will

be exchanged at the rate of 2.29 new shares for each share of Barrett stock, and that General Chemical Co. will be exchanged on a basis of 3.10 new stock for each share of the present General Chemical Co. stock. The terms under which the Semet-Solvay Co. will be taken in have not been determined, and will depend largely upon the adjustment that is made with reference to the entry of the National Aniline & Chemical Co.

Application will be made to list the new stock on the New York Stock Exchange and it is believed that it will be listed at about \$70 per share and pay dividends at the rate of 6 per cent per annum.

Operation of Government Nitrate Plants Is Urged

Grinnell Jones, chief of the chemical division of the U. S. Tariff Commission, in his recent article published in the *Quarterly Journal of Economics*, summarizes some of his investigations regarding the fixation and uses of nitrogen both in peace and in war. After giving the arguments which have been advanced as to the future policy of the United States with respect to the Muscle Shoals nitrate plant and other plants, this author concludes his article as follows:

A discussion of the pros and cons of private and Government operation of manufacturing enterprises is beyond the scope of this article. The important question is whether the plants are to be operated or dismantled. To allow them to stand idle is nearly equivalent to dismantling them, because they would rapidly deteriorate. Without an experienced operating staff and the constant improvements which come with operating experience they would be of little use in an emergency. If they can earn interest on any figure above their sale price as junk it will be profitable for the Government from a purely financial point of view to have them operated. Moreover, if operated they will be an important military asset and, if the need ever arises, will insure that the United States can make itself independent of imports of nitrate from Chile, just as Germany did. Should this need never arise these plants will continue to furnish a large supply of nitrogenous fertilizers, and thus increase the food supply. There can be no danger of excessive supplies of fertilizer material. There is plenty of land to put it on which has never received a pound of commercial fertilizer. In some way, and soon, the existing legal obstacles to the operation of the plants should be removed in order that they may forthwith contribute to the production of food for a starving world.

Whitehead Made Commissioner of Patents

Vacancies in the offices of Commissioner and First Assistant Commissioner of Patents were filled on Aug. 9 by recess appointments by the President. Robert F. Whitehead is to succeed James T. Newton, who recently resigned as Commissioner of Patents. The new First Assistant Commissioner is Melvin H. Coulston.

Both of the new appointees are lawyers. Mr. Whitehead received his professional training at the University of Virginia and Mr. Coulston at Cornell University. Each has been a member of the Patent Office staff for more than eighteen years. They have occupied positions in the various grades of examiners and are thoroughly familiar with the workings of the office.

Dr. Parsons on the Chemical Industry in Europe

Italy has the foundation of a number of great chemical industries well laid, in the opinion of Dr. Charles L. Parsons, secretary of the American Chemical Society, who just has returned from a three-months' trip in which he looked into chemical matters in several of the European countries. When the lack of raw materials and the scarcity of coal are considered, the Italian chemical development is little short of wonderful, he says. Italy, however, is making effective use of its two great assets, water power and cheap labor. In addition, full advantage is being taken of its supplies of sulphur, salt and the few other raw materials which Italy possesses.

While many chemical lines are being developed, the coal-tar and rubber industries are being conducted on a much larger scale than are any other individual chemical activities. Due to the coal shortage, electrification of the Italian railroads is being extended rapidly, Dr. Parsons reports. He predicts that all the railroads in Switzerland will have been electrified in the very near future.

In Rome Dr. Parsons attended the meeting of the International Union of Pure and Applied Chemistry. He is vice-president for the United States.

The chemical industries of Germany are only staggering along, Dr. Parsons asserts. Coal shortage, transportation difficulties and inability to secure raw materials are obstacles which the German industries are not surmounting with great success. He was particularly impressed with the practical applications which are being made in Germany of liquid oxygen as an explosive. These explosives are being used successfully on small operations, as well as in large mines and extensive works requiring blasting. The Germans have developed machines for the making of liquid oxygen which can be placed on motor trucks and operated by the truck's engine. Machines of this character are made as small as seven liters an hour capacity. He believes that liquid oxygen explosives could be used to great advantage in the United States.

Dr. Parsons made a special study of the application of oxidation of ammonia for the production of nitrous oxides to be used in the chamber process of manufacturing sulphuric acid. Germany is using ammonia almost entirely, he observed. Even in England 30 per cent of the sulphuric acid is being made by the newer process. He satisfied himself that large savings are being made over processes using Chilean saltpeter. He is confidently of the opinion that saltpeter is certain to be displaced in the sulphuric acid industry in this country.

In Scotland Dr. Parsons inspected dye works and paid a visit to the oil shale field.

Decreased American Production of Soda Ash in 1919

The domestic production of sodium carbonate in the form of soda ash was greatly curtailed in 1919. The sales amounted to only 981,354 tons, valued at \$29,824,245, as compared with 1,390,628 tons, valued at \$35,635,520, in 1918, according to R. C. Wells, of the United States Geological Survey, Department of the Interior.

The decreased demand in 1919 was well reflected in the price of soda ash quoted in the New York market. The year began with a sharp decline to \$1.40 a hundred pounds for carload lots, the lowest price quoted for at

least three years, from which there has been a slow and steady rise to the present price of \$3.50 a hundred.

Soda ash is one of the cheapest and most widely used chemicals manufactured. It is used in making glass, soap, paper, caustic soda, chemicals, drugs, paints, leather, enamel ware, and cleansing compounds. Most of it is made from common salt, but a small quantity is obtained directly from the water of Owens Lake, in southeastern California.

The exports of soda ash in 1919 amounted to 50,481 short tons, valued at \$2,656,608. This material was shipped principally to Canada, Brazil, Sweden, Mexico, and Australia, named in order of decrease in quantity exported. The imports amounted to only 415 short tons, valued at \$12,998.

Notes of the Chemical Warfare Service

The Chemical Warfare Service will have about twenty commissions of the lower grades to award this fall. In an effort to arouse interest in obtaining these commissions the heads of twenty-five technical colleges have been apprised of the fact in the hope that some of their students will apply for the places.

The results of the recent examination for commissions are expected by Aug. 20.

With the idea of stimulating outside research on military gases General A. A. Fries plans to request a co-operative agreement with the American Chemical Society. He believes a way can be found to keep the profession interested in the idea of working on gas problems. General Fries points out that it cannot be hoped to secure sufficient appropriations in peace time to conduct the volume of research on military gases which should be in progress. Since all nations are paying considerable attention to chemical warfare, he believes it will be necessary to obtain a considerable amount of outside research if the United States keeps pace with other nations in this regard.

In order that cadets of the United States Military Academy may have a better idea of the uses of gases in warfare the Chemical Warfare Service is staging a series of demonstrations at Lakehurst, N. J., near the cadets' summer camp. Of the new class of cadets twenty-two have applied for transfer to the C. W. S. This is particularly pleasing to General Fries. He points out that while chemists are the most important need of the service, men with military training also are highly essential, since the work of the chemists would be useless unless the gas troops had sufficient military training to allow the orderly use of the chemists' product.

The chlorine plant of the Chemical Warfare Service at Belle, W. Va., has been sold for \$300,000. This is 40 per cent of the original cost of the plant. Since the plant was built under war pressure, almost regardless of cost, the realization is regarded as a very fair one.

Leather Construction in Organs and Player Pianos

Quite an extensive report of the kinds of leather used in the manufacture of certain parts of organs and player pianos has been issued to tanners, dealers and manufacturers. At a conference held in New York on July 20, between the tanners and splitters and a representative of the Bureau of Standards it was decided to experiment with sheepskin skivers in order to produce leather in this country as satisfactory as that now imported.

Growth of the Union Tank Car Co.

During the past two years U.T.L.X. cars have grown from 18,000 to 26,000 in number. The Union Tank Car Co.'s equipment consists entirely of modern all-steel cars of the latest design and built substantially in excess of Master Car Builders' specifications. Entirely aside from its twenty-one shops for the repair of cars, the company's cars alone at present-day valuations very largely exceed the total of its security issues. Such cars cost today in excess of \$3,000, at which figure its 26,000 cars would have a valuation of \$78,000,000.

On the dissolution of the old Standard Oil Co. of New Jersey this subsidiary, formerly known as the Union Tank Line Co., was turned adrift and, incidentally, was compelled to borrow \$1,000,000 immediately required for working capital. By the end of 1917 it had built up a surplus of \$5,463,000 and by the end of 1919 this surplus amounted to \$9,398,000. A record of its net earnings, before deducting depreciation and federal taxes, is as follows:

1919.....	\$6,694,168	1915.....	\$1,606,439
1918.....	6,051,375	1914.....	1,183,568
1917.....	4,467,465	1913.....	1,713,789
1916.....	2,683,145	1912.....	1,815,902

The business of a tank car company consists of owning and keeping in repair tank cars which it leases to the oil-refining companies. Not being a common carrier, it is not subject to the jurisdiction of the Interstate Commerce Commission or of the state commissions and therefore fixes its own charges for the use of cars in ordinary business negotiation with those whom it serves.

Southern Cotton Oil Earnings Over \$2,000,000

The annual statement of the Southern Cotton Oil Co. for the fiscal year ended May 31 shows assets of \$37,256,600 and earnings of \$2,156,688 over dividends, etc.

ASSETS			
Capital assets:			
Real estate, plants and other permanent investments.....		\$12,027,597.82	
Stocks owned.....		746,707.04	
			\$12,774,304.86
Current assets:			
Raw materials, supplies and finished product.....		\$15,255,079.47	
Accounts receivable.....	\$4,936,452.54		
Bills receivable.....	871,443.39		
	\$5,807,895.93		
Less—reserve for doubtful accounts and rebate of interest.....	338,187.21		
		5,469,708.72	
Liberty bonds (at market).....		344,450.00	
Cash in banks and on hand.....		3,198,644.85	
			24,267,883.04
Interest, insurance, etc., paid in advance.....		214,413.03	
			\$37,256,600.93
LIABILITIES			
Capital stock.....		\$10,000,000.00	
Current liabilities:			
Bills payable.....	\$7,575,745.00		
Accounts payable and other liabilities, including provision for Federal taxes.....	1,514,140.84		\$9,089,885.84
Reserves:			
For depreciation.....		\$421,944.41	
For summer repairs.....		170,000.00	
For insurance (fire and casualty).....		155,199.71	747,144.12
Surplus:			
At May 31, 1919.....		\$16,262,882.97	
Add—earnings for year ended May 31, 1920.....		2,156,688.00	
		\$18,419,570.97	
Deduct—dividends paid.....		1,000,000.00	
			\$17,419,570.97
			\$37,256,600.93
* After paying and charging to operating expenses for repairs and replacements.....			
			\$2,157,150.45

Co-operation of Bureau of Standards With the American Committee on Electrolysis

Early in the year definite arrangements were made by the Bureau of Standards with the American Committee on Electrolysis, which represents all of the great national associations of utility companies, for co-operative work between that Committee and the Bureau in conducting an extensive research in the field of electrolysis mitigation. After this arrangement had been made, the Committee asked the Bureau to outline a program of research work to be carried out jointly, and such a program was formulated by the Bureau and approved by the Committee. During the last four months a number of somewhat extended investigations have been carried out in co-operation with this Committee in several Middle Western cities. This work has been confined largely, and almost exclusively, to the effect of pipe drainage on underground systems, especial attention being given to the possibility of joint electrolysis on high resistance joints and interchange of current between drained systems. Some attention has also been given to the three-wire systems of power distribution and also to automatic substation installation as a means of electrolysis mitigation. This joint investigation is an extremely important one and it is hoped that means will be found for continuing it during the coming year.

Need of Study on the Changes in the Structure of Hardened Steels Upon Tempering

Work has been started by the Bureau of Standards on quite an elaborate series of examinations to determine the changes which occur in the structure of hardened steels upon tempering. Very little information is available on this subject, and in particular, good micrographs, demonstrating the changes which occur, are rare. It can be shown by such other methods as magnetic tests and density determinations that pronounced changes occur in the hardened steel upon tempering, but the changes in the microstructure are much less plainly marked. For this reason there is need for more careful study of this phase of the metallography of steel. The specimens to be studied will include six different types, varying in carbon content from 0.07 per cent to considerably above 1 per cent. The steel will be hardened by quenching in water from various temperatures, and the length of time at which the material is held at the quenching heat will also be taken into consideration.

Refractories for the Glass Industry

The Bureau of Standards has commenced an investigation having for its object the development of improved refractories out of which to construct pots, etc., for the glass industry, with particular reference to their resistance to corrosion. The principle adopted has been to study systematically such bodies composed of siliceous bond clays mixed with aluminous grog and of aluminous bond with siliceous grog. In this matter it is hoped that the various possible combinations will be covered. A large number of crucibles have already been made from these mixtures. These are being fired, and will then be subjected to the action of a corrosive barium glass. Upon breaking the crucibles, the depth of penetration and degree of attack of the glass upon the material of the crucible will be determined. In addition, the transverse strength of the mixture, both in the dried and in the fired state, as well as the shrinkage, will be measured.

Changes in Exports and Imports of Chemicals

Material increases were shown in both exports and imports of chemicals in June, 1920, as compared with June of last year. This is shown by the latest returns to the Bureau of Foreign and Domestic Commerce. During June, 1920, imports of duty-free chemicals totaled \$12,160,739 and dutiable chemicals totaled \$6,100,996. This compares with \$2,940,273 and \$5,356,904 respectively for June, 1919. The chemicals exported in June, 1920, were valued at \$15,649,608. This compares with \$12,266,274 in June, 1919.

The imports of coal-tar products in June, 1920, totaled \$658,225 in value, as compared with \$341,322 in June, 1919.

The total gums imported in June, 1920, amounted to 14,144,032 lb., valued at \$5,217,950. This compares with imports of 4,605,105 lb., valued at \$1,460,760, in June, 1919.

Acids exported in June, 1920, were valued at \$565,347, as compared with exports valued at \$561,242 in June, 1919. Exports of dyes and dyestuffs totaled \$3,851,180 in June, 1920, as compared with \$1,392,346 in June of last year. Exports of sodas in June, 1920, were valued at \$2,404,080. The exports of June, 1919, were valued at \$1,336,299.

The following tables are intended to show the changes in foreign trading, with records of a few chemicals which move in lesser volume:

IMPORTS OF CHEMICALS		
	June, 1919 Lb.	June, 1920 Lb.
Ammonia, muriate of	157,682	889,999
Arsenic, sulphide of	176,384	351,312
Fusel oil	90,318	662,176
Iodine, crude or resublimed	24,717	none
Lime, chloride of	none	33,984
Potash, hydrate of	12,000	197,253
Potash, nitrate of	none	536,645
EXPORTS OF CHEMICALS		
Calcium carbide	3,407,436	986,393
Glycerine	429,791	87,420
Lime, acetate of	688,041	262,443
Potash, chlorate	36,989	510,438

Consideration of Others Will Help Coal Shortage

Alarm over the coal shortage, especially in the Western fields, has developed to a point of economic hysteria which is not justified by the facts as investigated through the coal committee of the Chicago Association of Commerce. Harry A. Wheeler, ex-president of the U. S. Chamber of Commerce and chairman of this committee, made an extended report of the findings recently in which he states that the transportation factor is largely responsible for the present shortage and offers the following seven remedies for getting the supply back to a normal basis:

1. Frankly recognize the situation as serious, but one that can be met. Do not get into a hysteria of bidding for coal, thus giving the speculator an opportunity.

2. Comply with every regulation and help the railroads to get the greatest amount of work out of their equipment.

3. Demurrage charges should be graded so that the penalty for retaining possession of equipment for longer than free time will become an expensive and unprofitable operation.

4. Annul the proposition to average the time of cars in possession of the shipper or consignee. This rule invites speculation and carelessness in the use of transportation. The Interstate Commerce Commission and railroads should abandon it during this emergency period.

5. Watchfulness over the rule of the commission which permits the railroads to consign cars to carry coal for their own needs. Railroads must be generous in sharing the equipment with the public.

6. Consumer should take what coal he can get and not wait for products of more distant fields.

7. Conservation. It is estimated that Chicago market may alone save 70,000 cars by March 31. Save coal, save transportation—these are most important.

Mr. Wheeler's analysis shows that common sense and thoughtfulness for the welfare of the other fellow are just as necessary during this reconstruction and readjustment period as it was during the war. Then the majority of men were actuated by unselfish patriotism, now all must work to rebuild business relations. The motive for consideration of general business interests, while not so strong, shows promise of development to a degree far beyond the expectations of the pre-war period.

The Reorganization of Nela Research Laboratories

Nela Research Laboratory was organized in 1908, under the directorship of Dr. Edward P. Hyde, as the Physical Laboratory of the National Electric Lamp Association. The name was changed to Nela Research Laboratory in 1913, when the National Electric Lamp Association became the National Lamp Works of the General Electric Co. For some years the laboratory was devoted exclusively to the development of those sciences on which the art of lighting has its foundation, but in 1914 its functions were extended by the addition of a small section of applied science, which had an immediate practical objective.

The section of applied science is now being largely extended as a separate laboratory of applied science under the immediate direction of M. Luckiesh, who becomes director of applied science, and a new building is being constructed to house this branch of the work, which will be carried forward with a staff of several physicists, an engineer, an architect and a designer, together with the necessary technical and clerical assistants.

Dr. Ernest Fox Nichols, formerly president of Dartmouth College and more recently professor of physics at Yale University, has accepted an invitation to assume the immediate direction of the laboratory of pure science, under the title of director of pure science. The work of this laboratory, which will be continued in the present building, will be somewhat further extended under the new organization.

The laboratory of pure science and laboratory of applied science will together constitute the Nela Research Laboratories, and will be co-ordinated under the general direction of Dr. Hyde, who becomes director of research.

Priority Transportation on Water-Refining Chemicals

Complying with a request of the Public Health Service, the American Railroad Association has issued a circular to all carriers asking that all chemicals used for water purification and the raw materials from which they are to be made be handled as expeditiously as possible. The circular covers the following material when consigned to municipal authorities or intended for the purification of public water supply: aluminum sulphate, bauxite, chlorine, calcium hypochlorite, soda ash, copperas, lime and empty cylinders for chlorine shipment.

The Relation of Composition to the Softening Point of Enamels

A knowledge of the effect of variation of composition of enamels on their softening points is of considerable technical importance in the enameled metal industry. While a few of those relations are understood in a general way, the results of a systematic investigation of the subject have never been published. The Bureau of Standards has undertaken a study of these relations and up to the present time seventy-four enamels, the compositions of which have been systematically varied, have been studied and their softening points determined.

From the data obtained so far it may be stated that the effect of various constituents on the softening point is not in accord with the chemical similarity of these constituents. For instance, certain basic oxides act as refractories in enamels, while others act as fluxes. The same is true for the so-called intermediate oxides and the acid oxides. In a given chemical group of oxides the fluxing effect is not in proportion to the molecular weight, and on the other hand equal percentage amounts of the various oxides do not have the same fluxing effect. The action of each oxide and mineral used in compounding enamels seems to be characteristic of that particular mineral or oxide and cannot be calculated by any system of *a priori* reasoning. It must be determined experimentally.

Hearings on Water-Power Regulations

Sections of the regulations which will be used in connection with the administration of the water-power act are being drafted and made the subject of hearings before officials of the Federal Power Commission. The regulations pertaining to form of application were the subject of criticism and discussion at a hearing on Aug. 12. On the following day representatives of banks and bond houses listened to the reading of the draft of the regulations pertaining to the financial aspects of the law. It is the policy of the commission to submit all regulations to those interested before promulgating them, with the idea of embodying such suggestions and criticisms as may be made.

Those interested in the Great Falls on the Potomac water-power project have been invited to attend a hearing before the Power Commission on Aug. 24. Each of the railroads entering Washington has been asked to send a representative to the hearing. The representatives of all large consumers of power in Washington and in the Great Falls area will be in attendance.

September Meeting of the International Bureau of Weights and Measures

The International Bureau of Weights and Measures will meet in Paris during September of this year. S. W. Stratton, director of the Bureau of Standards, has recently sailed to attend these sessions as the official representative of the United States.

There is in contemplation a considerable increase in the functions of the International Bureau to include other standards than those of simple weights and measures. This idea of extension of activity has been approved by representatives of the American Physical Society, the National Academy of Science and the National Research Council. It is expected that if the plan is adopted the International Bureau of Weights and Measures will have custody of numerous other types of standards and will eventually undertake the study of

physical values and promulgation of constants based upon the best available information. Such constants would doubtless be adopted by most of the interested countries in the form of an international convention with respect to units and standards.

Electrical Smelting Steel Plant Established in Sao Paulo

The establishment in Ribeirao Preto of the Cia. Electrica Metalurgica Brasileira, whose object is the operation of a large electrical smelting plant, marks a new epoch in the industrial development of the State of Sao Paulo. Assistant Trade Commissioner Connell reports that the above-named company, in conjunction with the Empresa Forca Luz de Ribeirao Preto, which is to furnish the power, made final arrangements on May 18 for the erection of the plant at Ribeirao Preto, and work will be started as soon as the American contractors who are to construct the mill can get their engineers on the ground. The capacity of the mill will be sixty tons of steel daily, but it is believed that the plant will turn out only about half that amount during the early months of its operation. The ore is to be mined in the southern part of the State of Minas Geraes and will be hauled seventy-five miles to the mill at Ribeirao Preto, which enjoys easy rail access to the port of Santos, whence ultimate distribution of the finished product will be made. It is interesting to note that the inauguration of this company in Brazil marks the beginning in South America of the use of electricity for smelting purposes.

Ceramic Day at the Chemical Exposition

The committee on co-operation of the American Ceramic Society, H. Schmidt, chairman, is planning to have a Ceramic Day at the Exposition of Chemical Industries Friday, Sept. 24. The custom of having a special day set aside for the members of the Society during which papers are presented is a welcome one, as is indicated by the considerable attendance during the Exposition in Chicago last fall.

Personal

MELVIN H. COULSTON has been appointed First Assistant Commissioner of Patents. Mr. Coulston has been a member of the Patent Office staff for more than eighteen years.

C. O. DICKEN, head of the chemical laboratory of the E. J. Brock & Sons Candy Co., delivered a talk before the Chicago Chemists' Club recently on "Chocolate Refining for Candy."

Dr. GUSTAV EGLOFF of Chicago has been in New York for several days.

Dr. RALPH H. MCKEE recently left for Europe, where he has been called in consultation.

W. T. SCHALLER, after an extended period in private employ, has returned to the position of mineralogical chemist with the United States Geological Survey which he formerly occupied.

GEORGE SLOCUM, who for the past five years has been with the United States Rubber Co., in Java and Sumatra rubber plantation work, spoke before the Chemists' Club at Chicago recently on "Java and Its Rubber Plantations."

GEORGE OTIS SMITH now has the distinction of having served longer as the director of the U. S. Geological Survey than any of his predecessors. He will have completed his fourteenth consecutive year as head of the bureau next

May. The opinion is very generally held that the long tenure of office on the part of the directors of the Survey has been an important factor in the bureau's effectiveness. Clarence King, the first director of the Survey, accepted the position forty years ago only to organize the bureau and served but one year. The remaining thirty-nine years have been divided practically equally among J. W. Powell, C. D. Walcott and Dr. Smith.

F. H. TUCKER has resigned as associate chemist of the Bureau of Standards to take a research position in the New York Laboratories of the Chile Exploration Co. Mr. Tucker has already begun work in his new position.

R. G. WALTEBERG, who for a number of years has been a physicist on the staff at the Bureau of Standards, has been appointed an industrial fellow of the International Nickel Co. to continue research work at the Bureau of Standards on properties of nickel and monel metal. This is one of a number of fellowships recently established at the bureau for co-operative investigation in special industrial lines.

ROBERT F. WHITEHEAD has been appointed Commissioner of Patents, succeeding James T. Newton, who resigned recently.

Dr. L. F. WHITMER, who has been an associate chemist at the Bureau of Standards for a number of years, has recently accepted appointment as associate professor in the department of chemistry of Lafayette College, Easton, Pa. He will have charge of metallurgy and certain inorganic courses in this department from the beginning of the next college year.

Book Reviews

PRACTICAL CHEMISTRY. By N. H. Black and James B. Conant. 474 pp. 251 illustrations. New York: MacMillan Co.

The number of elementary introductory books on chemistry is very large and growing still larger, just as is the subject itself. The authors of "Practical Chemistry" are to be congratulated in having written a book that will give the beginner not only a grasp of the fundamental facts of the science but also some notion of the part played by chemistry in industrial life. The illustrations are excellent and should make it easy for the student to get quick and lasting impressions. While the text has been primarily prepared for class work, there is no doubt that it is suitable for general reading. Copies of it should be in every plant library so that all employees who desire a good start in chemical reading will have it available.

WALLACE SAVAGE.

Current Market Reports

The Iron and Steel Market

Pittsburgh, August 13, 1920.

For a month in which the steel market was reported as dull as it was last month the July unfilled tonnage statement of the Steel Corporation was very favorable, as the unfilled obligations increased by 139,651 tons during the month, this being 100,000 tons more than the 38,351-ton increase of June, and as shipments probably increased 50,000 or 100,000 tons from June to July the bookings appear to have increased by 150,000 or 200,000 tons. Yet July was one of the two proverbially dull midsummer months and June, being the end month of a quarter, should have witnessed the booking of a considerable tonnage of routine business which is simply entered up quarter by quarter.

It is understood that the Steel Corporation subsidiaries have not been soliciting any business, but are simply accept-

ing such part of the business offered them as is to their liking. On account of the disparity in quoted prices by the Steel Corporation and the independents the corporation must hold its facilities for its regular trade. As to the independents, it is said that they are not soliciting business either. Some of them are sold up only a short distance ahead, but to solicit business would be to provoke a question as to why the quotations remain above those of the Steel Corporation, if additional orders are desired.

As an offset to the 11,118,468 tons of unfilled obligations which the Steel Corporation reports at the end of July there is the considerable tonnage that has been produced but not shipped, but this amounts to only about a month's output. At 90 per cent of rated capacity, 52,500 tons per working day, the output in nine months would be approximately equal to the unfilled obligations reported, so that it may be taken that the corporation is booked up approximately to April 1, 1921, as an average date.

STEEL PRODUCTION OFF

The rate of steel ingot output declined about 6 per cent from June to July, the July rate being about 39,900,000 gross tons per annum. The computation is based upon the monthly report of the American Iron and Steel Institute, showing the output of thirty companies which made 84.03 per cent of the total output of 1918, these companies reporting 2,980,690 tons for June and 2,802,818 tons for July. The rate of production of pig iron by steel works furnaces decreased about 2.2 per cent from June to July, the rate of steel ingot production decreasing about 6 per cent, as noted above. However, there is the disturbing element that Independence Day was a steel-mill holiday but not a blast-furnace holiday, and such facts are taken into account in the computations used for this report of production rates. The result is that while the thirty companies produced 178,000 tons less of steel ingots in the month of July than in the month of June the steel interests in general produced about 20,000 tons more pig iron in the latter month. Accordingly it would appear that they accumulated some pig iron, this being quite natural seeing that they accumulated large tonnages of semi-finished steel, production of finished steel being restricted by car shortage and large stocks already accumulated. The circumstance is interesting in view of the fact that merchant pig iron is scarce and furnacemen show a disposition to advance their prices.

In the past few days the Carnegie Steel Co., after a long interval, has been in the market for heavy melting steel scrap and has bought a total variously estimated at 20,000 or 30,000 tons, some of the purchases being at \$29, when ten days ago the market was quotable at barely over \$27 to consumers. It is normal, however, for the buyer of a large tonnage to pay more than the quoted price, for the dealers are buying odd lots every day and selling large lots only occasionally. Usually scrap purchases by the Carnegie Steel Co. are taken as indicating that the steel market has a particularly favorable prospect, but in this case the purchases may have been occasioned by the company having left so much of its steel lately in semi-finished form, whereby the production of works scrap has been temporarily curtailed.

PIG IRON ADVANCING

For several months there has been a waiting attitude in the pig iron market, the question being whether buyers or sellers would act first. The scarcity of prompt iron has caused some buyers to seek iron at whatever price has to be paid and the furnaces are showing a strong disposition to advance prices. Basic recently sold at \$46.50, valley, in important transactions, an advance over the previously quoted market of 50c. Bessemer remains quotable at \$47, valley, and foundry at \$46, valley, but some furnaces are holding out for much higher prices and it is a question whether additional purchases of any of the three grades could be made at the prices here named. Whether an advance in the market predicated upon an insistent demand for early deliveries can be molded into a general buying movement for extended deliveries remains to be seen, but at the moment it looks as if the furnaces had the upper hand. An advancing pig iron market is somewhat anomalous.

lous, seeing that steel prices show more likelihood of declining, by the independents dropping to the Steel Corporation level, yet pig iron prices are already too high in relation to steel prices.

TRANSPORTATION

If anything there is more complaint in the trade regarding transportation conditions than a week or two ago, yet there is no doubt that on the whole shipments of pig iron and steel products have been increasing for a fortnight, if not for a longer period. The shippers had hoped that transportation conditions would be entirely righted by this time, which accounts for their dissatisfaction now. Shipments of pig iron are probably equal to production, but steel still seems to be accumulating, though at a low rate.

Steel interests in the Pittsburgh, valley and Cleveland districts have discovered that a large number of gondola cars owned by railroads endeavoring to serve them are beyond the Mississippi River and are making representations to the Interstate Commerce Commission looking to the issuance of an order that these cars be returned to owner roads, just as box cars owned by Western roads were ordered west some time ago in order to move grain. Car supplies in the Connellsville coke region have been distinctly better last week, and this owing to cars moving somewhat less slowly. It is remarkable that placements have been as good as they have been, in view of the very slow movement. Various furnace interests have related their experience of having to have en route more than double as much coke as normally in order that daily receipts may be up to requirements, which of course means that the cars involved are moving at less than half normal speed.

Lake Superior iron ore shipments down the lakes in July amounted to 9,638,606 tons, a trifle more than in July, 1919, and a trifle less than in July, 1918, which held the record for a July. The season total to Aug. 1 is 26,079,111 tons. Taking the three preceding years as a criterion, using the rate of pig iron production shown each July as the basis of requirements to the opening of navigation the following year, the shipments this year to Aug. 1 fall 3.8 per cent of the indicated tonnage, but that is practically nothing in view of the millions of tons of ore regularly carried at furnaces and on Lake Erie docks. Shipments from Lake Erie docks have been a trifle below their normal relations to the vessel movement.

Several purchases of sheet bars, for conversion into sheets, have just been made at \$70. At least four mills sold at this price, and two or three others would recognize the price. A trifle over a fortnight ago sheet bars brought \$75, also for conversion.

The Chemical and Allied Industrial Markets

New York, August 13, 1920.

The slight activity exhibited in the chemical market during the last week has been confined almost entirely to actual requirements. Spot supplies on some of the items are increasing and as a result there has been an easing up of the firm tone that has been noticeable for some time previously; *formaldehyde* is among the foremost and spot sales are being made as low as 48c. per lb., with the possibility of still further drop due to the improved *alcohol* situation. However, former quotation of \$5.50 per gal. for the *ethyl* grade still holds. Despite the increased cost of production manufacturers are finding it impossible to raise their prices with resale material being offered below the present market. This is the case in *sulphuric acid*, 60 deg., which can be obtained as low as \$12 per ton, and as a result producers are awaiting the fall buying, which it is hoped will be very heavy. The increased arrivals of *barium chloride* from abroad have held this item down and it can be obtained in fairly large quantities at \$150 per ton, although there is not enough material on hand yet to meet the normal demand. Due to weak inquiry both *caustic soda* and *potash* fell off during the week and the former is now quoted at 27@28c. per lb., while the latter is being held at \$6@6.50 per cwt. in resale lots.

COAL-TAR PRODUCTS

There is very little to report in this market during the week, as business has been very dull. The closing of a number of textile plants has cut off the only source of demand that has kept this market moving and a return to normal activity is not looked for before the fall. Some idea of the rise in *naphthalene* can be gained from the following table:

	Crushed	Flake	Balls
May, 1919.....	\$0.06-\$0.08	\$0.07-\$0.08	\$0.10-\$0.11
March, 1920.....	.06—.08	.07—.08	.10—.11
April, 1920.....	.08—.09	.07—.08	.08—.10
May, 1920.....	.15	.15	.15
June, 1920.....	.15	.15-17	.16-18
July, 1920.....	...	.19	.19
August, 1920.....	...	.18-20	.19-21

The sudden rise in April was caused by a combination of circumstances; first, scarcity of the crude material, second, the dropping out of the market of one of the largest producers when a fire partly dismantled the plant. Although it is nominally quoted at 19@21c. today in small resale lots, deliveries on contracts, written in the early part of the year, are still being made at 6@8c. crushed, 7@8c. flake and 8@10c. per lb. for balls.

NAVAL STORES AND FLOTATION OILS

Heavy buying inquiry from England and South America is putting this market back on the road to normal prices. Advances have been made in all grades of *rosin*, and although there is very little material available in the local market Savannah has been active during the week, especially in the last few days. *Turpentine* has been quiet during the week, with very few inquiries, the former quotation of \$1.70 still holding firm, with Savannah quoting \$1.56 per gal. The *flotation oils* are somewhat weaker than last week, *pine oil*, steam dist., sp.gr. 0.930-0.940, being listed at \$3.15, against \$2.30 per gal. of previous report. *Crude turpentine*, sp.gr. 0.900-0.970, is down to \$1.75 from \$2 per gal.

VEGETABLE OILS

Conditions remain unchanged with low prices still prevailing and a tendency to still lower levels is noticeable. *Soya bean oil*, tank cars, f.o.b. Pacific Coast, sold as low as 9½c. per lb. for spot material, with very few buyers available. Practically the same condition exists in *peanut oil*, concessions being made on spot material and nobody willing to take these offerings. All grades of *coconut oil* are down, *Ceylon* being listed at 17½@18c., against 18½@19c. of last week, while *Cochin* grade fell from 16@16½c. to 15@16c. per lb.

The Baltimore Market

Baltimore, Md., August 12, 1920.

Since last report, the outstanding feature in the fertilizer business has been the heavy export demand and final consummation of order for about 25,000 tons acid phosphate, which has had a tendency to materially strengthen the market.

During the past week the car supply has been somewhat better, and the fertilizer manufacturers are now bending every effort toward getting off their shipments of complete fertilizer for the fall season, but there is still a shortage of labor which is handicapping the trade in general in this section.

Prime cottonseed meal for September-December shipment has further eased off, and is now obtainable as low as \$7.75 per unit of ammonia, delivered Baltimore, no charge for phosphoric acid, potash or bags. Of course this price is based on the present rates of freight, and the increase which will become effective this month is to be for buyers' account. The manufacturers, however, feel that after increased rates go into effect, which will be correspondingly reflected in the delivered price per unit of ammonia, sellers of cottonseed meal will still further reduce their f.o.b. quotations, and are therefore holding off in their purchases awaiting further developments.

ACID PHOSPHATE

Practically all the important sellers of this material are now sold up, and the large export order has about

cleaned up all the summer surplus. It is reported that 25,000 tons was sold for shipment abroad at \$19 per ton, in bulk, basis 16 per cent delivered to vessel at producer's works, Baltimore, for goods testing 16 to 18 per cent, pro rata charge for excess over 16 per cent. August-September shipments are practically unobtainable, and October-December is nominally quoted at \$19@20 per ton, in bulk, basis 16 per cent, pro rata charge for excess. The lower figure is for shipment by water, while the outside price is for car shipments, with sellers hesitating to take on any important business on account of the car situation, and such orders as are booked for shipment in this manner are subject to car supply permitting. Both phosphate rock and sulphuric acid are in short supply, with only occasional offerings on the market, which are eagerly taken up at market prices. Every indication points not only to the market being maintained, but ruling higher later on when it will be more a question of securing the goods than of price.

TANKAGE

While there has been an easing up in the Western market, which is now nominally \$7.50 and 10c., f.o.b. Chicago, this price* with freight added figures considerably higher than buyers have to pay Eastern packers, and foreign ammoniates are again coming into favor, as these are obtainable on a lower basis than packing house byproducts. Foreign nitrogenous material testing about 8 to 9 per cent ammonia and guaranteed 80 per cent availability is obtainable at \$7.50 per unit, delivered Baltimore, but as only a limited tonnage of this class of material is required by the fertilizer manufacturers for their fall mixtures, more interest is shown in later deliveries than for August-September arrivals.

NITRATE OF SODA

There has been a further recession in the market on this article, due to the lower rate of sterling exchange. August-September deliveries are now obtainable at \$3.65@ \$3.70, October-December \$3.80@ \$3.90, and January-April \$3.95@ \$4.

It is understood that the easiness of the market is attributed to the foreign exchange situation, and if there should be an upward turn, there will doubtless be a corresponding increase in nitrate, as this material is being firmly controlled at producing point.

POTASH

There have been no new developments in this since last report, as the fertilizer manufacturers are all holding off in their purchases in anticipation of their being able to secure their supplies for the coming spring season at materially lower prices than now prevail. In the meantime, only meager supplies of foreign potash are being received, and these are being quoted at somewhat lower than the previous market.

Early deliveries of muriate are now obtainable at \$2.40@ \$2.50, kainit at \$2@ \$2.10, and manure salt at \$2.10@ \$2.20.

FISH SCRAP

The market remains stationary at \$7.50 and 10c. for dry unground scrap, f.o.b. factories, subject to catch and if made. However, on account of financial conditions the buying demand has eased up, but producers are comfortably fixed by having contracts which were booked some time ago.

BONE MEAL

While the market on 3 and 50 per cent steamed bone meal remains at \$54 per ton in buyers' bags, and little interest being shown at this price, every indication points to still higher prices ruling on this article, as well as raw bone meal, when the increased freight rates go into effect. The tonnage available is very limited, and while the present high prices have curtailed consumption, the material is not being produced in a large way, and any lots quoted under the market are rapidly absorbed.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride.....lb.		\$0.65 - \$0.75
Acetone.....lb.	\$0.15 - \$0.20	.21 - .22
Acid, acetic, 28 per cent.....cwt.	3.50 - 3.75	4.00 - 4.50
Acetic, 56 per cent.....cwt.	6.50 - 7.50	8.50 - 9.50
Acetic, glacial, 99½ per cent, carboys.....cwt.	14.00 - 16.00	16.25 - 17.50
Boric, crystals.....lb.	.15 - .16	.16 - .19
Boric, powder.....lb.	.15 - .16	.17 - .20
Citric.....lb.	.78 - .80	.82 - .84
Hydrochloric (nominal).....cwt.	2.00 - 3.00	3.10 - 4.00
Hydrofluoric, 52 per cent.....lb.	.13 - .14	.14 - .15
Lactic, 44 per cent tech.....lb.	.11 - .11½	.12 - .16
Lactic, 22 per cent tech.....lb.	.04 - .05	.06 - .07
Molybdic, C. P.....lb.	4.00 - 4.50	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric).....lb.	.06 - .07	.07 - .08
Nitric, 40 deg.....lb.	.07 - .08	.08 - .09
Nitric, 42 deg.....lb.	.55 - .57	.60 - .65
Oxalic, crystals.....lb.	.14 - .23	.24 - .25
Phosphoric, Ortho, 50 per cent solution.....lb.	.28 - .35	.40 - .50
Picric.....lb.	2.30 - 2.55	2.60 - 2.65
Pyrogallol, resublimed.....lb.	12.00 - 16.00	
Sulphuric, 60 deg., tank cars.....ton		18.00 - 20.00
Sulphuric, 60 deg., drums.....ton	16.00 - 17.00	
Sulphuric, 66 deg., tank cars.....ton	26.00 - 28.00	
Sulphuric, 66 deg., drums.....ton		
Sulphuric, 66 deg., carboys.....ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars.....ton	27.00 - 30.00	37.00 - 42.00
Sulphuric, fuming, 20 per cent (oleum) drums.....ton	28.00 - 30.00	38.00 - 42.00
Sulphuric, fuming, 20 per cent (oleum) carboys.....ton	32.00 - 35.00	40.00 - 45.00
Tannic, U. S. P.....lb.	1.45 - 1.50	1.55 - 1.65
Tannic (tech).....lb.	.60 - .70	.80 - .90
Tartaric, crystals.....lb.	.74 - .77	.74 - .77
Tungstic, per lb. of WO.....lb.	1.20 - 1.40	1.20 - 1.40
Alcohol, Ethyl (nominal).....gal.	5.10 - 5.50	6.00 - 7.00
Alcohol, Methyl, 95%.....gal.		3.25 - 3.30
Alcohol, Methyl, pure.....gal.		3.50 - 3.55
Alcohol, denatured, 188 proof (nominal).....gal.		1.10 - 1.15
Alcohol, denatured, 190 proof (nominal).....gal.		1.05 - 1.10
Alum, ammonia lump.....lb.	.05 - .05½	.05 - .06
Alum, potash lump.....lb.	.08 - .08½	.09 - .09½
Alum, chrome lump.....lb.	.15 - .18	.19 - .20
Aluminium sulphate, commercial.....lb.	.04 - .05	
Aluminium sulphate, iron free.....lb.	.06 - .07	
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	.09 - .10	.11 - .12
Ammonia, anhydrous, cylinders (100-150 lb.).....lb.	.34 - .35	.35 - .40
Ammonium carbonate, powder.....lb.	.16 - .16½	.17 - .18
Ammonium chloride, granular (white sal-ammoniac) (nominal).....lb.	.16 - .16½	.17 - .18
Ammonium chloride, granular (gray sal-ammoniac).....lb.	.13 - .13½	.13 - .14
Ammonium nitrate.....lb.	.09 - .10	.11 - .14
Ammonium sulphate.....lb.	.07 - .07½	.08 - .08½
Amylacetate.....gal.		5.00 - 5.25
Amylacetate tech.....gal.		4.75 - 5.25
Arsenic, oxide, lumps (white arsenic).....lb.	.15 - .16	.16 - .17
Arsenic, sulphide, powdered (red arsenic).....lb.	.20 - .21	.22 - .25
Barium chloride.....ton	150.00 - 160.00	
Barium dioxide (peroxide).....lb.	.21 - .23	.24 - .25
Barium nitrate.....lb.	.10 - .12	.12 - .13
Barium sulphate (precip.) (blanc fixe).....lb.	.04 - .05	.05 - .06
Bleaching powder (see calcium hypochlorite).....		
Blue vitriol (see copper sulphate).....		
Borax (see sodium borate).....		
Brimstone (see sulphur, roll).....		
Bromine.....lb.	.70 - .90	1.00 - 1.05
Calcium acetate.....cwt.	3.50 - 3.55	
Calcium carbide.....lb.	.04 - .04½	.04 - .05
Calcium chloride, fused, lump.....ton	25.00 - 30.00	35.00 - 45.00
Calcium chloride, granulated.....lb.	.01 - .01½	.02 - .03
Calcium hypochlorite (bleaching powder).....cwt.		4.50 - 6.00
Calcium peroxide.....lb.		1.50 - 1.70
Calcium phosphate, monobasic.....lb.		.75 - .80
Calcium sulphate, pure.....lb.		.25 - .30
Carbon bisulphide.....lb.	.08 - .09	.10 - .11
Carbon tetrachloride, drums.....lb.	.14 - .15	.16 - .17
Carbonyl chloride (phosgene).....lb.		.80 - 1.05
Caustic potash (see potassium hydroxide).....		
Caustic soda (see sodium hydroxide).....		
Chlorine, gas, liquid-cylinders (100 lb.).....lb.	.09 - .09½	.10 - .10½
Chloroform.....lb.	.40 - .43	.44 - .47
Cobalt oxide.....lb.		2.00 - 2.05
Copperas (see iron sulphate).....		
Copper carbonate, green precipitate.....lb.	.27 - .28	.29 - .31
Copper cyanide.....lb.		.65 - .70
Copper sulphate, crystals.....lb.	.08 - .09	.09 - .09½
Cream of tartar (see potassium bitartrate).....		
Epsom salt (see magnesium sulphate).....		
Ethyl Acetate Com. 85%.....gal.	1.10 - 1.30	1.40 - 1.50
Ethyl Acetate pure (acetic ether 98% to 100%).....lb.		1.25 - 1.50
Formaldehyde, 40 per cent (nominal).....gal.	.40 - .45	.48 - .50
Fusel oil, ref. (nominal).....gal.		5.25 - 6.00
Fusel oil, crude (nominal).....gal.		
Glauber's salt (see sodium sulphate).....		
Glycerine, C. P. drums extra.....lb.		.26 - .28
Iodine, resublimed.....lb.	4.30 - 4.35	4.40 - 4.45
Iron oxide, red.....lb.		.13 - .20
Iron sulphate (copperas).....cwt.		2.20 - 2.50
Lead acetate, normal.....lb.		.13 - .16
Lead arsenate (paste).....lb.	.11 - .12	.13 - .17
Lead nitrate, crystals.....lb.		.10 - 1.00
Litharge.....lb.	.14 - .15	.15 - .16
Lithium carbonate.....lb.		1.50 - 1.60
Magnesium carbonate, technical.....lb.	.12 - .13	.15 - .16
Magnesium sulphate, U. S. P.....100 lb.	3.50 - 3.90	4.00 - 4.50
Magnesium sulphate, commercial.....100 lb.		3.50 - 3.60
Nickel salt, double.....lb.		.14 - .16
Nickel salt, single.....lb.		.13 - .14
Phosgene (see carbonyl chloride).....		
Phosphorus, red.....lb.	.50 - .55	.60 - .65
Phosphorus, yellow.....lb.		.35 - .37
Potassium bichromate.....lb.	.50 - .55	.52 - .60

	Carlots	Less Carlots
Potassium bitartrate (cream of Tartar).....lb.	\$0.52 - \$0.56	\$0.57 - \$0.58
Potassium bromide, granular.....lb.	..70 - .73	..70 - .73
Potassium carbonate, U. S. P.....lb.	..50 - .55	..56 - .60
Potassium carbonate, crude.....lb.	..20 - .25	..26 - .28
Potassium chloride, crystals.....lb.	..16 - .17	..18 - .20
Potassium hydroxide (caustic potash).....lb.	..27 - .28	..29 - .33
Potassium iodide.....lb.	..35 - .36	..35 - .36
Potassium permanganate.....lb.	..17 - .17	..19 - .21
Potassium prussiate, red.....lb.	..75 - .80	..85 - .95
Potassium prussiate, yellow.....lb.	..90 - 1.00	1.05 - ..
Potassium sulphate (powdered).....ton	\$225.00 - 240.00	..
Rochelle salts (see sodium potas. tartrate).....	..	..
Salammoniac (see ammonium chloride).....	..	..
Salt soda (see sodium carbonate).....	..	..
Salt cake.....ton	40.00 - 50.00	..
Silver cyanide (nominal).....oz.	1.25 - ..	..
Silver nitrate (nominal).....oz.	..60 - .62	..
Soda ash, light.....100 lb.	3.20 - 3.50	..
Soda ash, dense.....100 lb.	3.55 - 3.65	..
Sodium acetate.....lb.	10 - 15	..
Sodium bicarbonate.....100 lb.	2.50 - 2.75	3.00 - 3.50
Sodium bichromate.....lb.	22 - 24	26 - 27
Sodium bisulphate (nitre cake).....ton	7.00 - 8.00	9.00 - 11.00
Sodium bisulphate Powdered, U.S.P.....lb.	..08 - .11	..
Sodium borate (borax).....lb.	..09 - .10	..11 - .12
Sodium carbonate (salt soda).....100 lb.	1.50 - 1.80	1.80 - 2.00
Sodium chlorate.....lb.	11 - 12	12 - 14
Sodium cyanide, 96-98 per cent.....lb.	25 - 30	32 - 35
Sodium fluoride.....lb.	18 - ..	19 - 20
Sodium hydroxide (caustic soda).....100 lb.	6.25 - 7.00	..
Sodium hyposulphite.....lb.	..03 - .04	..
Sodium molybdate.....lb.	2.50 - ..	3.25 - ..
Sodium nitrate.....100 lb.	3.00 - 3.25	3.75 - 4.00
Sodium nitrite.....lb.	16 - 18	19 - 20
Sodium peroxide, powdered.....lb.	32 - 35	35 - 40
Sodium phosphate, dibasic.....lb.	03 - 04	04 - 05
Sodium potassium tartrate (Rochelle salts) lb.	..	39 - 40
Sodium prussiate, yellow.....lb.	23 - 27	31 - 32
Sodium silicate, solution (40 deg.).....lb.	01 - 01	02 - 02
Sodium silicate, solution (60 deg.).....lb.	02 - 03	04 - 05
Sodium sulphate, crystals (Glauber's salt) cwt.	1.60 - 1.70	1.75 - 2.50
Sodium sulphide, crystal, 60-62 percent (conc) lb.	09 - 10	10 - 11
Sodium sulphite, crystals.....lb.	04 - 0.4	04 - 05
Strontium nitrate, powdered.....lb.	15 - 18	19 - 20
Sulphur chloride red.....lb.	08 - 09	10 - 10
Sulphur, crude.....ton	16.00 - 20.00	..
Sulphur dioxide, liquid, cylinders.....lb.	09 - ..	10 - 12
Sulphur (sublimed), flour.....100 lb.	..	3.80 - 4.35
Sulphur, roll (brimstone).....100 lb.	..	3.40 - 3.90
Tin bichloride (stannous).....lb.	42 - 44	45 - 46
Tin oxide.....lb.	..	55 - 65
Zinc carbonate, precipitate.....lb.	16 - 18	19 - 20
Zinc chloride, gran.....lb.	13 - 13	13 - 17
Zinc cyanide.....lb.	45 - 49	50 - 60
Zinc dust.....lb.	11 - 12	12 - 13
Zinc oxide, U. S. P.....lb.	17 - 25	..
Zinc sulphate.....lb.	03 - 03	04 - 06

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude.....lb.	\$1.40 - \$1.50
Alpha naphthol, refined.....lb.	1.60 - 1.70
Alpha naphthylamine.....lb.	53 - 55
Aniline oil, drums extra.....lb.	33 - 34
Aniline salts.....lb.	40 - 42
Anthracene, 80% in drums (100 lb.).....lb.	90 - 1.00
Benzaldehyde (f.o.c.).....lb.	2.00 - 2.10
Benidine, base.....lb.	1.35 - 1.40
Benidine, sulphate.....lb.	1.15 - 1.25
Benzoic acid, U.S.P.....lb.	90 - 1.00
Benzoate of soda, U.S.P.....lb.	80 - 90
Benzol, pure, water-white, in drums (100 lb.).....gal.	35 - 40
Benzol, 90% in drums (100 lb.).....gal.	33 - 38
Benzyl chloride, 95-97% refined.....lb.	35 - 40
Benzyl chloride, tech.....lb.	25 - 35
Beta naphthol benzoate (nominal).....lb.	3.50 - 4.00
Beta naphthol, sublimed (nominal).....lb.	..
Beta naphthol, tech (nominal).....lb.	85 - 95
Beta naphthylamine, sublimed.....lb.	2.25 - 2.40
Creosol, U. S. P., in drums (100 lb.).....lb.	18 - 19
Ortho-cresol, in drums (100 lb.).....lb.	23 - 25
Creasylic acid, 92-99%, straw color, in drums.....gal.	1.05 - 1.15
Creasylic acid, 95-97%, dark, in drums.....gal.	1.00 - 1.05
Creasylic acid, 50%, first quality, drums.....gal.	65 - 75
Dichlorobenzol.....lb.	08 - 10
Diethylaniline.....lb.	1.50 - 1.60
Dimethylaniline.....lb.	1.35 - 1.45
Dinitrobenzol.....lb.	30 - 35
Dinitrochlorbenzol.....lb.	32 - 35
Dinitronaphthalene.....lb.	45 - 55
Dinitrophenol.....lb.	40 - 45
Dinitrotoluol.....lb.	35 - 40
Dip oil, 25% tar acids, car lots, in drums.....gal.	38 - 40
Diphenylamine (nominal).....lb.	80 - 85
H-acid (nominal).....lb.	2.00 - 2.25
Metaphenylenediamine.....lb.	1.25 - 1.30
Monochlorobenzol.....lb.	18 - 20
Monoehtylaniline.....lb.	2.00 - 2.40
Naphthalene crushed, in bbls. (250 lb.).....lb.	..
Naphthalene, flake.....lb.	19 - ..
Naphthalene, balls.....lb.	..
Naphthionic acid, crude.....lb.	75 - 85
Nitrobenzol.....lb.	14 - 19
Nitro-naphthalene.....lb.	40 - 50
Nitro-toluol.....lb.	18 - 25
Ortho-amidophenol.....lb.	3.25 - 4.25
Ortho-dichlor-benzol.....lb.	15 - 20
Ortho-nitro-phenol.....lb.	80 - 1.25
Ortho-nitro-toluol.....lb.	25 - 40
Ortho-toluidine.....lb.	35 - 40
Para-amidophenol, base.....lb.	2.50 - 3.00
Para-amidophenol, HCl.....lb.	2.50 - 3.00
Para-dichlor-benzol.....lb.	08 - 12
Paranitraniline.....lb.	1.35 - 1.40

Para-nitro-toluol.....lb.	1.35 - 1.50
Paraphenylenediamine.....lb.	2.50 - 2.65
Paratoluidine.....lb.	2.00 - 2.25
Phthalic anhydride.....lb.	60 - 70
Phenol, U. S. P., drums (dest.), (240 lb.).....lb.	12 - 20
Pyridin.....gal.	2.00 - 3.50
Resorcin, technical.....lb.	4.25 - 4.50
Resorcin, pure.....lb.	6.25 - 6.75
Salicylic acid, tech., in bbls. (110 lb.).....lb.	50 - 52
Salicylic acid, U. S. P.....lb.	50 - 60
Salol.....lb.	90 - 1.00
Solvent naphtha, water-white, in drums, 100 gal. gal.	33 - 35
Solvent naphtha, crude, heavy, in drums, 100 gal. gal.	23 - 26
Sulphanilic acid, crude.....lb.	32 - 35
Toluidine.....lb.	1.70 - 2.50
Toluidine, mixed.....lb.	45 - 55
Toluol, in tank cars.....gal.	35 - ..
Toluol, in drums.....gal.	38 - 40
Xylidine, drums, 100 gal.....lb.	50 - 65
Xylol, pure, in drums.....gal.	47 - 50
Xylol, pure, in tank cars.....gal.	45 - ..
Xylol, commercial, in drums, 100 gal.....gal.	32 - 35
Xylol, commercial, in tank cars.....gal.	30 - ..

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark.....lb.	\$0.36 - \$0.39
Beeswax, refined, light.....lb.	37 - 38
Beeswax, white pure.....lb.	63 - 68
Carnauba, No. 1, (nominal).....lb.	90 - 95
Carnauba, No. 2, regular (nominal).....lb.	55 - 60
Carnauba, No. 3, North Country.....lb.	35 - 36
Japan.....lb.	17 - 18
Montan, crude.....lb.	35 - 36
Paraffine waxes, crude match wax (white) 105-110 m.p.....lb.	09 - 09
Paraffine waxes, crude, scale 124-126 m.p.....lb.	09 - 10
Paraffine waxes, refined, 118-120 m.p.....lb.	11 - 12
Paraffine waxes, refined, 125 m.p.....lb.	12 - ..
Paraffine waxes, refined, 128-130 m.p.....lb.	14 - 15
Paraffine waxes, refined, 133-135 m.p.....lb.	16 - 17
Paraffine waxes, refined, 135-137 m.p.....lb.	17 - 18
Stearic acid, single pressed.....lb.	24 - 25
Stearic acid, double pressed.....lb.	25 - 26
Stearic acid, triple pressed.....lb.	27 - 28

NOTE—Paraffine waxes very scarce.

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr. 0.930-0.940.....gal.	\$2.15
Pine oil, pure, dest. dist.....gal.	1.80
Pine tar oil, ref., sp. gr. 1.025-1.035.....gal.	48
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla. gal.	35
Pine tar oil, double ref., sp. gr. 0.965-0.990.....gal.	85
Pine tar, ref., thin, sp. gr. 1.080-1.060.....gal.	36
Turpentine, crude, sp. gr. 0.900-0.970.....gal.	1.75
Hardwood oil, f.o.b. Mich., sp. gr. 0.960-0.990.....gal.	35
Pinewood creosote, ref.....gal.	52

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.....280 lb.	\$14.00 - \$16.25
Rosin E-I.....280 lb.	16.00 - 16.75
Rosin K-N.....280 lb.	17.00 - 17.20
Rosin W. G. W. W.....280 lb.	17.25 - 17.50
Wood rosin, bbl.....280 lb.	15.00 - ..
Spirits of turpentine.....gal.	1.70 - ..
Wood turpentine, steam dist.....gal.	..
Wood turpentine, dest. dist.....gal.	..
Pine tar pitch, bbl.....200 lb.	.. - 8.50
Tar, kiln burned, bbl. (500 lb.).....bbl.	14.50 - 15.00
Retort tar, bbl.....500 lb.	15.00 - 15.50
Rosin oil, first run.....gal.	72 - ..
Rosin oil, second run.....gal.	75 - ..
Rosin oil, third run.....gal.	92 - ..

Solvents

73-76 deg., steel bbls. (85 lb.).....gal.	\$0.40
70-72 deg., steel bbls. (85 lb.).....gal.	38
68-70 deg., steel bbls. (85 lb.).....gal.	37
V. M. and P. naphtha, steel bbls. (85 lb.).....gal.	29

Crude Rubber

Para-Upriver fine.....lb.	\$0.33 - \$0.34
Upriver coarse.....lb.	21 - 22
Upriver caucho ball.....lb.	21 - 21
Plantation—First latex crepe.....lb.	30 - ..
Ribbed smoked sheets.....lb.	29 - ..
Brown crepe, thin, clean.....lb.	27 - ..
Amber crepe No. 1.....lb.	29 - ..

Oils

VEGETABLE

The following prices are f.o.b., New York for carload lots.

Castor oil, No. 3, in bbls.....lb.	\$0.16 - \$0.18
Castor oil, AA, in bbls.....lb.	19 - ..
China wood oil, in bbls.....lb.	17 - 18
Cocanut oil, Ceylon grade, in bbls.....lb.	15 - 16
Cocanut oil, Cochinchina grade, in bbls (nominal).....lb.	16 - 16
Corn oil, crude, in bbls.....lb.	14 - 15
Cottonseed oil, crude (f.o.b. mill).....lb.	10 - 11
Cottonseed oil, summer yellow.....lb.	12 - 13
Cottonseed oil, winter yellow.....lb.	17 - 18
Lined oil, raw, car lots (domestic).....gal.	1.50 - ..
Lined oil, raw, tank cars (domestic).....gal.	1.40 - ..
Lined oil, boiled, car lots (domestic).....gal.	1.56 - ..

Olive oil, commercial.....	gal.	3.00	—	3.10
Palm, Lagos.....	lb.	.10	—	.10
Palm, bright red.....	lb.	.10	—	.12
Palm, Niger.....	lb.	.11	—	.12
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.12	—	.12
Peanut oil, refined, in bbls.....	lb.	.17	—	.18
Rapeseed oil, refined in bbls.....	gal.	1.40	—	1.50
Rapeseed oil, blown, in bbls.....	gal.	1.60	—	1.70
Soya bean oil (Manchurian), in bbls. N. Y.....	lb.	.14	—	.14
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.09	—	.11

FISH

Winter pressed Menhaden.....	gal.	\$0.90	—	\$1.05
Yellow bleached Menhaden.....	gal.	0.95	—	1.05
White bleached Menhaden.....	gal.	1.00	—	1.25
Blown Menhaden.....	gal.	1.00	—	1.20

Miscellaneous Materials

All f. o. b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	\$22.00	—	\$25.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	18.00	—	20.00
Barytes, crude, 88% @ 94% ba., Kings Creek	net ton	8.00	—	10.00
Barytes, ground, white, f.o.b. Cartersville, Ga.	net ton	23.00	—	25.00
Barytes, ground, off-color, f.o.b. Cartersville	net ton	16.00	—	19.30
Barytes, crude, 88% @ 94% ba., Cartersville	net ton	12.00	—	12.00
Barytes, floated, f.o.b. St. Louis	net ton	26.50	—	28.00
Barytes, crude, min. 98% ba., Missouri	net ton	11.00	—	11.25
Blanc fixe, dry.....	lb.	.05	—	.06
Blanc fixe, pulp.....	net ton	60.00	—	80.00
Casein.....	lb.	.15	—	.18
Chalk, domestic, extra light.....	lb.	.05	—	.06
Chalk, domestic, light.....	lb.	.04	—	.05
Chalk, domestic, heavy.....	lb.	.04	—	.05
Chalk, English, extra light.....	lb.	.05	—	.07
Chalk, English, light.....	lb.	.05	—	.06
Chalk, English, dense.....	lb.	.04	—	.05
China clay, (Kaolin) crude, f.o.b. mines, Georgia	net ton	9.00	—	12.00
China clay (Kaolin) washed, f.o.b. Georgia	net ton	12.00	—	15.00
China clay (Kaolin) powdered, f.o.b. Georgia	net ton	18.00	—	22.00
China clay (Kaolin) crude f.o.b. Virginia points	net ton	8.00	—	12.00
China clay (Kaolin) ground, f.o.b. Virginia points	net ton	15.00	—	40.00
China clay (Kaolin), imported, lump.....	net ton	25.00	—	35.00
China clay (Kaolin), imported, powdered.....	net ton	30.00	—	60.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	7.50	—	8.00
Feldspar, crude, f.o.b. Maine	net ton	7.50	—	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00	—	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00	—	20.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00	—	20.00
Feldspar, ground, f.o.b. Baltimore	net ton	30.00	—	30.00
Fuller's earth, granular, f.o.b. Fla.	net ton	25.00	—	25.00
Fuller's earth, powdered, f.o.b. Fla.	net ton	18.00	—	18.00
Fuller's earth, imported, powdered	net ton	35.00	—	40.00
Graphite (dust polish grade 30%) Ashland, Ala.	lb.	.....	—	.01
Graphite (dust facing grade 50%) Ashland, Ala.	lb.	.....	—	.02
Graphite, crucible, 80% carbon Ashland, Ala.	lb.	.....	—	.05
Graphite, crucible, 90% carbon Ashland, Ala.	lb.	.....	—	.10
Graphite, crucible, 85% carbon	lb.	.....	—	.08
Graphite, crucible, 88% carbon	lb.	.....	—	.09
Graphite, crucible, 90% carbon	lb.	.....	—	.10
Pumice stone, imported, lump.....	lb.	.04	—	.50
Pumice stone, domestic, lump.....	lb.	.06	—	.....
Pumice stone, ground.....	lb.	.04	—	.07
Quartz (acid tower) fist to head, f.o.b. Baltimore	net ton	.....	—	10.00
Quartz (acid tower) 1 1/2 in. f.o.b. Baltimore	net ton	.....	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	.....	—	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00	—	7.50
Shellac, orange fine.....	lb.	1.45	—	1.50
Shellac, orange superfine.....	lb.	1.55	—	.....
Shellac, A. C. garnet.....	lb.	1.05	—	1.15
Shellac, T. N.....	lb.	1.20	—	1.30
Sopstone.....	ton	15.00	—	25.00
Talc, paper-making grades, f.o.b. Vermont.....	ton	10.00	—	20.00
Talc, roofing grades, f.o.b. Vermont.....	ton	9.00	—	15.00
Talc, rubber grades, f.o.b. Vermont.....	ton	10.00	—	15.00
Talc, powdered, Southern, f.o.b. cars	ton	29.00	—	25.00
Talc, imported.....	ton	60.00	—	70.00
Talc, California Talcum Powder grade	ton	20.00	—	35.00

Refractories

Chrome brick, f.o.b. Chester, Pa., carlots.....	net ton	90-100	—	90-100
Chrome brick, 9-in. str. and sizes, f.o.b. Baltimore.....	net ton	90-95	—	90-95
Fire clay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	50-55	—	50-55
Fire clay brick, 1st quality, f.o.b. St. Louis.....	1,000	45-50	—	45-50
Fire clay brick, 1st quality, f.o.b. New Jersey.....	1,000	75-80	—	75-80
Fire clay brick, 2d quality, 9-in. shapes f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	45-55	—	45-55
Magnesite brick, 9 in. straights, f.o.b. Baltimore.....	net ton	100-110	—	100-110
Magnesite brick, 9-in. sizes and shapes larger than 9-in.	net ton	90-100	—	90-100
Magnesite brick, f.o.b. Chester.....	net ton	90-100	—	90-100
Silica brick, 9-in. and 9-in. sizes, Chicago district.....	1,000	55-60	—	55-60
Silica brick, f.o.b. Birmingham.....	1,000	51-55	—	51-55
Silica brick, f.o.b. Mt. Union, Pa.....	1,000	55-60	—	55-60

Ferro-Alloys

All f.o.b. Works

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon, carlots.....	lb.	.17	—	.18
Ferro-chrome, per lb. of Cr. contained, 4-6% carbon, carlots.....	lb.	.19	—	.20
Ferro-manganese, 76-80% Mn, domestic.....	gross ton	200.00	—	225.00
Ferro-manganese, 76-80% Mn, English.....	gross ton	195.00	—	220.00
Spiegelisen, 18-22% Mn.....	gross ton	75.00	—	75.00
Ferro-molybdenum, 50-60% Mo, per lb. of Mo.....	lb.	2.25	—	2.75
Ferro-silicon, 10-15%.....	gross ton	60.00	—	65.00
Ferro-silicon, 50%.....	gross ton	80.00	—	90.00
Ferro-silicon, 75%.....	gross ton	150.00	—	160.00
Ferro-tungsten, 70-80%, per lb. of contained W.....	lb.	1.10	—	1.15
Ferro-uranium, 35-50% of U, per lb. of U content.....	lb.	7.00	—	7.00
Ferro-vanadium, 30-40% per lb. of contained V.....	lb.	6.50	—	7.75

Ores and Semi-finished Products

All f.o.b. Mines, Unless Otherwise Stated

Chrome ore, Calif. concentrates, 50% min.....	unit	.60	—	.65
Chrome ore, 40% min., Cr ₂ O ₃ , f.o.b. Atlantic Seaboard.....	unit	.77	—	.85
*Coke, foundry, f.o.b. ovens.....	net ton	20.00	—	20.00
*Coke, furnace, f.o.b. ovens.....	net ton	18.00	—	20.00
*Coke, petroleum, refinery, Atlantic Seaboard.....	net ton	24.00	—	24.00
Fluor spar, lump, f.o.b. Tonuco, New Mexico.....	net ton	17.50	—	17.50
Fluor spar, standard, domestic washed gravel Kentucky and Illinois mines.....	net ton	25.00	—	27.50
Ilmenite, 52% TiO ₂ per lb. ore.....	lb.	.01	—	.02
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	unit	.70	—	.80
Manganese ore, chemical (MnO ₂).....	gross ton	75.00	—	85.00
Molybdenite, 85% MoS ₂ per lb. of MoS ₂ , N. Y.....	lb.	.75	—	.85
Monazite, per unit of ThO ₂	unit	42.00	—	42.00
Pyrites, Spanish, fines, c.i.f. Atlantic seaport.....	unit	.12	—	.....
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport.....	unit	.16	—	.....
Pyrites, Spanish, run of mines, c.i.f. Atlantic seaport.....	unit	.12	—	.14
Pyrites, domestic, fines.....	unit	.12	—	.14
Rutile, 95% TiO ₂ per lb. ore.....	lb.	.15	—	.....
Tungsten, Scheelite, 60% WO ₃ and over, per unit of WO ₃	unit	7.00	—	7.00
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃ , N. Y. C.....	unit	6.00	—	7.00
Uranium ore (Carnotite) per lb. of U ₃ O ₈	lb.	2.75	—	3.00
Uranium oxide, 96% per lb. contained U ₃ O ₈	lb.	2.75	—	3.00
Vanadium pentoxide, 99%.....	lb.	12.00	—	14.00
Vanadium Ore, per lb. of V ₂ O ₅ contained.....	lb.	1.25	—	1.25
Zircon, washed, iron free.....	lb.	.10	—	.....

*Nominal

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic.....	19.00
Aluminum, 98 to 99 per cent.....	33.00
Antimony, wholesale lots, Chinese and Japanese.....	7.50
Nickel, ordinary (Ingot).....	43.00
Nickel, electrolytic.....	45.00
Tin, Straits, spot.....	48.50
Lead, New York, spot.....	9.25
Lead, E. St. Louis, spot.....	8.90
Zinc, spot, New York.....	8.25
Zinc, spot, E. St. Louis.....	7.90 @ 8.40

OTHER METALS

Silver (Commercial).....	oz.	\$0.99
Cadmium.....	lb.	1.40 @ 1.50
Bismuth (500 lb. lots).....	lb.	2.70
Cobalt.....	lb.	2.50 @ 3.00
Magnesium (f.o.b. Niagara Falls).....	lb.	1.75
Platinum.....	oz.	95 @ 105
Iridium.....	oz.	350.00
Palladium.....	oz.	100.00
Mercury.....	75 lb.	88.00 @ 90.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled.....	33.50
Copper bottoms.....	38.00
Copper rods.....	38.00 @ 40.00
High brass wire and sheets.....	30.25
High brass rods.....	27.00
Low brass wire and sheets.....	28.50
Low brass rods.....	29.00
Brazed brass tubing.....	38.25
Brazed bronze tubing.....	41.75
Seamless copper tubing.....	34.00
Seamless high brass tubing.....	33.00

SCRAP METALS

	Cents per Lb. Buying Price
Aluminum, cast scrap.....	23.00 @ 23.50
Aluminum, sheet scrap.....	23.00 @ 23.50
Copper, heavy machinery comp.....	14.50 @ 15.00
Copper, heavy and wire.....	15.25 @ 15.75
Copper, light and bottoms.....	13.00
Copper, heavy cut and crucible.....	16.25
Brass, heavy.....	9.50 @ 10.00
Brass, light.....	7.25 @ 7.75
No. 1 clean brass turnings.....	9.00 @ 9.50
No. 1 comp. turnings.....	12.50 @ 13.50
Lead, tea.....	4.75 @ 5.00
Lead, heavy.....	7.25 @ 7.50
Zinc, scrap.....	5.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 1/2 in. and larger, and plates 1/2 in. and heavier, from jobbers' warehouses in the cities named:

	New York		Cleveland		Chicago	
	Current	One Month Ago	Current	One Month Ago	Current	One Month Ago
Structural shapes.....	\$4.47	\$3.97	\$3.47	\$5.00	\$3.37	\$3.97
Soft steel bars.....	4.47	4.12	3.37	4.50	3.27	3.87
Soft steel bar shapes.....	4.47	4.12	3.37	3.27	3.87	3.37
Soft steel bands.....	6.32	5.32	4.07	6.25	.....	.....
Plat.s, 1/2 to 1 in. thick.....	4.67	4.17	3.67	4.50	3.57	4.17

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Colorado

DENVER—The Tungsten Products Co. is building a chemical reduction plant for the exclusive treatment of radium ores in connection with its plant at Boulder. Estimated cost, \$7,000.

Illinois

CHICAGO—The Charles H. Milles Fdry. Co., 2443 West 21st Pl., plans to build a 1-story, 100x200-ft. plant at West 35th and South Leavitt Sts. Estimated cost, \$150,000.

MONTICELLO—The Bd. Educ. has awarded the contract for the construction of a 2-story, 111x172-ft. school, to Alfred Nelson, 36 West Rand St., Chicago, at \$200,000. A chemical laboratory will be installed in same. Noted June 23.

Iowa

CENTERVILLE—The Judy Mfg. Co. has awarded the contract for the construction of a 1-story, 60x150-ft. foundry, to the B. S. Staley Constr. Co., at \$30,000.

Kentucky

LOUISVILLE—The Louisville Chemical Co., 108 South 3rd St., is in the market for machinery for its new factory. B. F. Gregory, pres.

Maryland

ANNAPOLIS—The Public Utilities Co. plans to construct gas-plant additions. Estimated cost, \$200,000.

Massachusetts

BOSTON—The Boston & Maine R.R. Co., North Station, will soon award contract for the construction of an overhead sewage disposal system, at Warren Bridge.

EAST EVERETT (Boston P. O.)—The Carpenter-Morton Co., 77 Sudbury St., Boston, has awarded the contract for the construction of a 4-story, 50x60-ft. factory on East Summer St., to J. E. Locatelli & Co., Inc., 46 Cornhill St., Boston. Estimated cost, \$75,000.

SOMERSET—N. S. Chase, engr., Borden Block, Fall River, will soon award contract for the construction of a 1-story, 70x160-ft. iron foundry. Estimated cost, \$50,000. Owner's name withheld.

Michigan

DETROIT—The National Alloys Co., Woodbridge St., plans to build a 1-story, 60x100-ft. foundry. Estimated cost, \$25,000. Horace H. Lane, Dime Bank Bldg., engr.

Minnesota

PINE ISLAND—The Bd. of Educ. plans to build a 2-story, 60x106-ft. high school. L. L. Cornwell, secy. Stebbins & Haxby, 445 Auditorium Bldg., Minneapolis, archts.

Montana

FORSYTH—John E. Edwards & Co. plans to build a sugar factory. Estimated cost, \$1,500,000.

Nebraska

MINATARE—The Great Western Sugar Co., Scotts Bluff, plans to build a sugar factory with a capacity of 1,200 tons.

New Hampshire

DOVER—The National Woodworking Machinery Co., B'way., has awarded the contract for the construction of a 1-story 50x100-ft. foundry, 1-story 35x200-ft. machine shop and a 1-story 40x100-ft. pattern shop on Locust St., to Chesley & Co., 11 Middle St. Estimated cost, \$125,000.

New Jersey

ATLANTIC CITY—The city is having plans prepared for the construction of a sewage disposal plant. Estimated cost, \$60,000. Clyde Potts, 30 Church St., New York City, engr.

Ohio

CANTON—The Bowman Bros. Drug Co., 3rd and Court Sts., N. W., has awarded the contract for the construction of a 2-story warehouse on Schroyer Ave., S. W., to the Van Orman Bros. Estimated cost, \$60,000.

CINCINNATI—Hill Griffith, 1262 State Ave., plans to build 1- and 4-story, 150x300-ft. addition to foundry. Estimated cost, \$100,000. Bert Baldwin, 2nd National Bank, engr.

CLEVELAND—The Cleveland Can Co., 1836 Euclid Ave., plans to build a 3-story factory. Estimated cost, \$200,000. J. A. Brown, 1836 Euclid Ave., mgr.

PIQUA—The Champion Fdry. Co. has awarded the contract for the construction of a 2-story factory to the Dorris Hunt Constr. Co., Dayton. Estimated cost, \$45,000.

URBANA—The United Paper Board Co. is having plans prepared for rebuilding and remodeling its plant recently destroyed by fire. Estimated cost, \$500,000.

Pennsylvania

PHILADELPHIA—The Taylor Wharton Iron & Steel Co., 25th and Washington Sts., has awarded the contract for the construction of a 1-story, 80x100-ft. machine shop addition at 51st and Grays Sts., to the Hughes-Foulkrod Co., Commonwealth Trust Bldg.

Rhode Island

CUMBERLAND—A. H. Humes, archt., 229 Main St., Pawtucket, will soon award the contract for the construction of a 1-story, 60x80-ft. factory on Abbott St., for the Standard Nut & Bolt Co. Estimated cost, \$25,000.

PAWTUCKET—The What Cheer Chemical Co., Grotto Ave., will build a 1-story addition to its factory. Estimated cost, \$35,000. Work will be done by day labor.

Texas

AMARILLO—The city plans to vote on a bond issue for the construction of an incinerator, \$18,000; sanitary disposal plant, \$18,000; sanitary sewers, \$60,000; fire alarm station, \$30,000; and a coliseum, \$200,000. Address the Mayor.

Wisconsin

CUMBERLAND—The city will build a sanitary sewer system and treatment plant. Estimated cost, \$80,000. Work will be done by day labor. Noted July 7.

GRAND RAPIDS—The Grand Rapids Fdry. Co. will build a 1-story, 50x104-ft. pattern shop here. Work will be done by day labor.

MENASHA—The Simple Gas Engine Wks. plans to build a 60x100-ft. foundry. J. D. Frankland, De Pere St., mgr.

WAUKESHA—The Waukesha Castings Co., 340 B'way., is in the market for new foundry equipment. W. Blair, purch. agt.

WEST ALLIS—The Nelson Pulley Co., 857 27th St., Milwaukee, will build a 1-story, 60x120-ft. machine shop and foundry. Work will be done by day labor.

Ontario

HAMILTON—The Steel Wks. of Canada, Harvey Lane, plans to build a 1- and 2-story steel plant and foundry. Estimated cost, \$300,000.

KAPUKASING—The Spruce Falls Co., Toronto, plans to build a pulp and paper mill here. Estimated cost, \$800,000.

ST. THOMAS—The Elgin Milk Products Co. plans to build a 2-story, 55x200-ft. condensed milk factory on Talbot St. Estimated cost, \$100,000.

ST. THOMAS—S. Gilbert, mgr., will soon award the contract for rebuilding the plant, which was recently destroyed by fire, of the Canada Iron Fdry. here.

Manufacturers' Catalogs

THE WELLMAN-SEEVER-MORGAN Co., Cleveland, O., calls attention to Bull. 51, on its new gas producer. This bulletin is practically a text-book on gas producers, and has also many illustrations, some in color.

PORTABLE MACHINERY Co., Passaic, N. J., has just published a 24-page catalog entitled "Portable Conveyors." This is complete with illustrations showing the various uses of the Scoop Conveyor and other portable conveyors manufactured by the company, and describes clearly the labor, time and money saving features of the machines in storing, reclaiming, loading and unloading material such as coal, coke, ashes, sand, gravel, crushed stone, fertilizer, cement, chemical, etc. Copies of the catalog will be sent free upon request to the manufacturers.

THE NATIONAL CARBON Co., Inc., New York, has issued a booklet entitled "The Carbon Electrode." The purpose of this booklet is to place in the hands of those interested in electric furnace operation certain suggestions relative to the handling, storage and use of carbon electrodes, and a comprehensive bibliography.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its 1920 meeting Dec. 27, 1920, to Jan. 1, 1921, at Chicago, Illinois.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Chicago, Sept. 7 to 10 inclusive.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in the Hotel Statler, Cleveland, Ohio, Sept. 30, Oct. 1 and 2.

AMERICAN FOUNDRYMEN'S ASSOCIATION will meet in Columbus, Ohio, Oct. 4 to 8 inclusive.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its one hundred and twenty-second meeting Aug. 20 to Sept. 3, on Lake Superior.

AMERICAN MINING CONGRESS will hold its next convention in Denver Nov. 15.

AMERICAN PEAT SOCIETY will hold its annual meeting at Madison, Wis., Sept. 2, 3 and 4, 1920.

AMERICAN PHYSICAL SOCIETY will hold a meeting Nov. 27 at the Case School of Applied Science, Cleveland, and the annual meeting, beginning Dec. 28, at Chicago, the latter being the occasion of the special quadrennial meeting of the American Association for the Advancement of Science and the Affiliated Societies.

AMERICAN STEEL TREATERS' SOCIETY, Chicago, will hold its second annual convention and exhibit, combined with the convention of the Steel Treating Research Society of Detroit, Mich., in the Coliseum Museum, Philadelphia, Pa., Sept. 14 to 18 inclusive.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS will hold its 14th annual convention at the Hotel Pennsylvania, New York City, Sept. 20 to 24, 1920.

ENGINEERING COUNCIL will hold its next meeting in Chicago Thursday, Oct. 21, 1920.

INSTITUTE OF METALS DIVISION OF THE A.I.M.E. will hold its usual joint meeting with the American Foundrymen's Association at Columbus, Ohio, during the week beginning Oct. 4.

IRON AND STEEL INSTITUTE (British) will hold its autumn meeting at Cardiff by invitation of the Ironmasters and Steel Manufacturers of South Wales and Monmouthshire. The date of the meeting will be Tuesday, Sept. 21, for the assembling of the members at Cardiff, and the formal proceedings will open on the morning of Wednesday, Sept. 22.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SIXTH) will be held in the Grand Central Palace, New York City, Sept. 20 to 25.

SOCIETY OF INDUSTRIAL ENGINEERS will hold its fall national convention at Carnegie Music Hall, Pittsburgh, Pa., Nov. 10, 11 and 12, 1920.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will hold its fall meeting at Saratoga Springs, N. Y., Sept. 1, 2 and 3.